MECHANICAL ENGINEERING

December 1960

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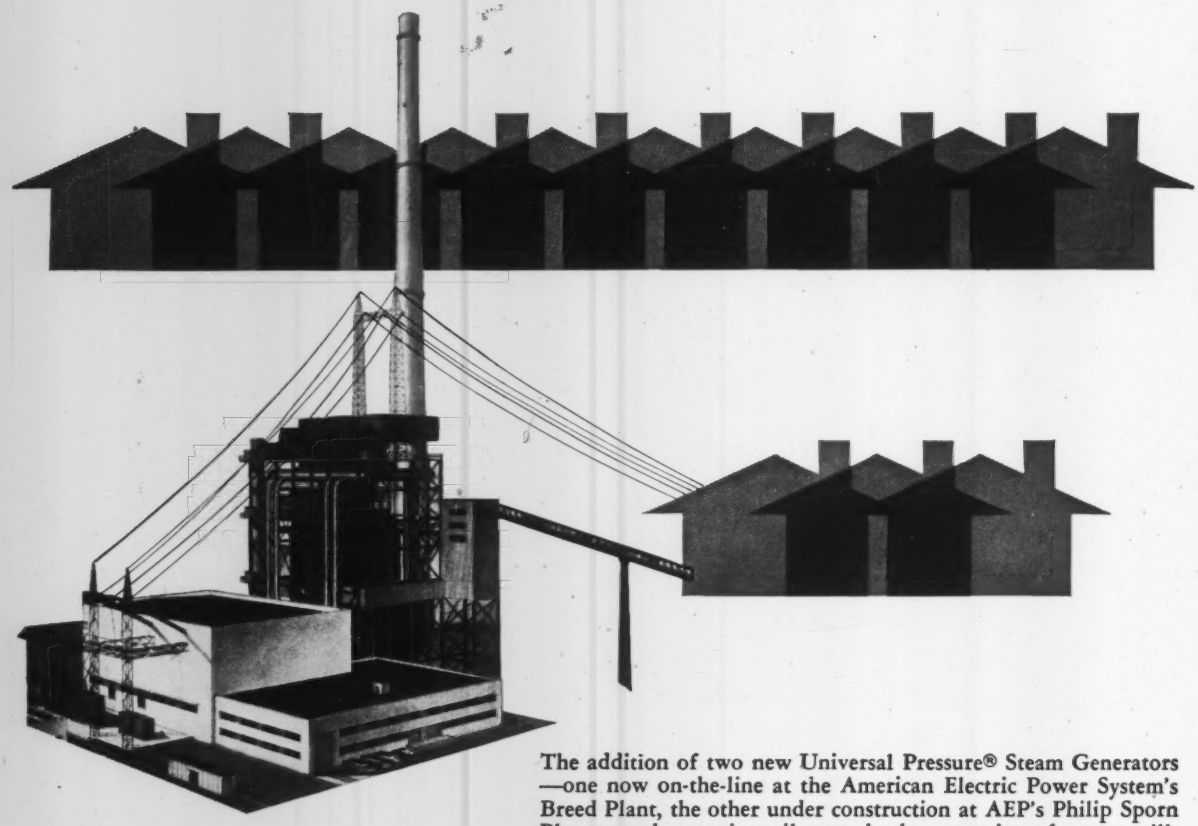
SPACE VEHICLES
VAPOR CYCLES
DIRECT CONVERSION
FOOD AND OXYGEN
POWER COMPONENTS
SEA-WATER DISTILLATION
SOLAR FURNACE
HEATING AND COOLING

Rugged Conveyer Belt

Electricity for an additional 130,000 homes ...without burning an extra ounce of coal!



The addition of two new Universal Pressure® Steam Generators —one now on-the-line at the American Electric Power System's Breed Plant, the other under construction at AEP's Philip Sporn Plant—marks a major milestone in the expansion of power utilities to meet America's surging demands for electricity.

Together, these units will provide steam at supercritical pressures (3500 psig at 1050 F/1050 F/1050 F) to generate about eight billion kilowatt hours of electricity annually. Each of these steam generators will consume a carload of coal every twenty minutes. Because of the improved cycle efficiency of these units, electricity generated from this fuel will be sufficient for the annual needs of over two million average American homes—130,000 more homes than could be supplied by burning the same amount of coal in the best generating stations now in operation in the world.

Net power of these stations is about twice that produced annually at Hoover Dam . . . yet cost of putting these new plants on stream (per kilowatt of electricity) will equal about 1/3 that of building a new Hoover Dam today.

Expansion is the measure of the future — and products of Babcock & Wilcox engineering and research will pace much of the nation and the utilities industry.

For more detailed information on the UP® Steam Generator and other B&W power generating systems and designs write: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G956

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

CARBORUNDUM'S TECHNICAL INFORMATION ON UNUSUAL REFRACTORIES **Data sheet**

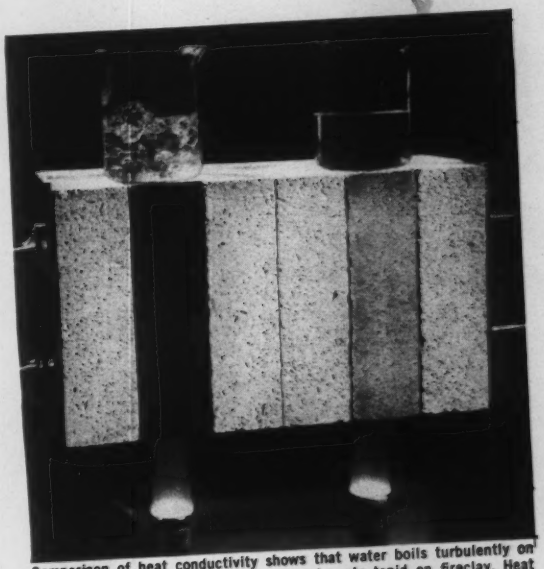
How to make use of

THERMAL CONDUCTIVITY

Although refractories are usually considered heat barriers, or insulators, some are actually excellent heat conductors. This conductivity factor can be used with advantage in many applications.

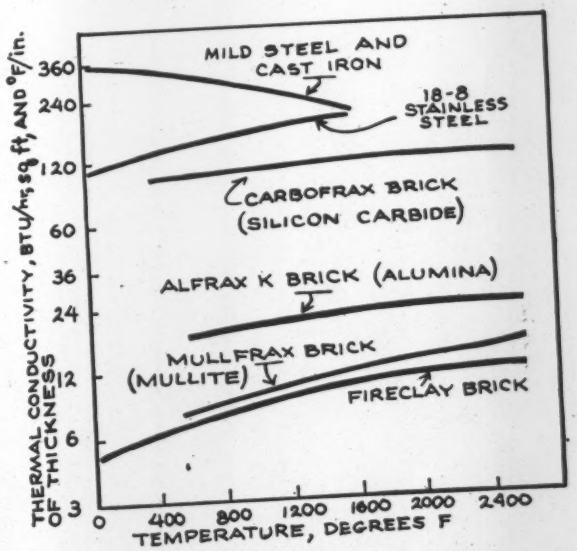
Silicon carbide refractories are among the best heat conductors known—with a heat transfer at 2200 F. roughly 11 times that of fireclay brick and 70% that of chrome-nickel steels. However, high nickel alloys lose strength rapidly above 1500 F. Silicon carbide refractories can be safely used above 2800 F. and still provide a fast rate of heat transfer.

Employed in an indirectly-heated application like a muffle, the much better heat conductivity of silicon carbide refractories can result in substantial fuel savings. For example, a silicon carbide 1½" thick wall needs a hot-face temperature of only 1571 F. to maintain a 1500 F. temperature in the work chamber. A fireclay wall of equal thickness would require a hot face temperature of 2337 F. Superior conductivity makes possible closer temperature control, particularly where conditions tend to produce wide temperature swings.



Comparison of heat conductivity shows that water boils turbulently on CARBOFRAX® silicon carbide brick; barely gets tepid on fireclay. Heat conductivity of CARBOFRAX brick is roughly 11 times that of fireclay and about 70% that of chrome-nickel steel. Thermal conductivity of CARBOFRAX brick is 109/Btu hr., sq. ft. and °F/in. of thickness.

The chart at left shows thermal conductivity of various Carborundum refractories—including silicon carbide, alumina, and mullite—as opposed to metals and fireclay brick. For the refractory best suited to your particular application, feel free to call on Carborundum's accumulated experience.



Coefficients of thermal conductivity for some of Carborundum's refractories and other materials at different mean temperatures. Information adapted from Figure 4, Carborundum "Refractories" Vol. 3, No. 5, December 1958. This bulletin, containing extensive technical information on the properties and applications of refractory-type products, is published bi-monthly. A request will put you on the mailing list.

Write today for your free copy of "Super Refractories by Carborundum." The address: Dept. ME120, Refractories Division, Perth Amboy, N. J.

For engineered refractories, count on **CARBORUNDUM®**

Season's
Best
Wishes...

MECHANICAL ENGINEERING

PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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VOLUME 82 • NUMBER 12 • DECEMBER, 1960

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THE COVER

How tough can a conveyer belt be made? The technician is measuring cover hardness, but the feature of this Goodyear belt is its woven carcass of nylon-reinforced cotton yarn, woven into an interlocking complex. Rubber rivets penetrate deep into the carcass to insure maximum cover adhesion. The belt becomes an endless unit through splicing and vulcanizing in the field (no fasteners or hooks), maintaining strength and cut-and-tear resistance. The belting is for iron ore and hard-rock mining as well as nonmining applications.

NEW SYSTEM OF MERIT RATINGS.....**K. D. Holland** 38

Can you reduce human capabilities to equations and numbers? Fact is, you do that consciously or subconsciously, when you evaluate others. Here is a method which gets away from guesswork and bias.

SOLAR ENERGY IN 1960.....**J. I. Yellott** 41

Score a win for the solar-energy men—their success in powering of satellite communication. Earthbound solar apparatus includes seawater distillation, heating and cooling, and the solar furnace.

THE DUCTED PROPELLER.....**August Raspet** 45

Put a shroud around the propeller and you get a sharp increase in static thrust, just the ticket for short take-off. Observe: The propeller twist will be different, and the duct must not stall.

KINEMATICS: A GERMAN-ENGLISH GLOSSARY.....**R. S. Hartenberg and T. P. Goodman** 49

Just any translation won't do. With so much of the literature of kinematics being of German origin, the designer of mechanical movements needs a guide to the German engineering vocabulary. Here it is.

COLLAPSIBLE CONTAINERS.....**N. H. Brown, Jr.** 54

This rubber tank is the prototype of the bulk packages destined to lead the evolution in the handling of dry, flowable products. Ship in bulk, but with a protective, storable, convenient container.

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Without productivity we couldn't have academic life or scientific study. Those things are made possible by surplus—surplus of material wealth and surplus of time. Engineers create productivity.

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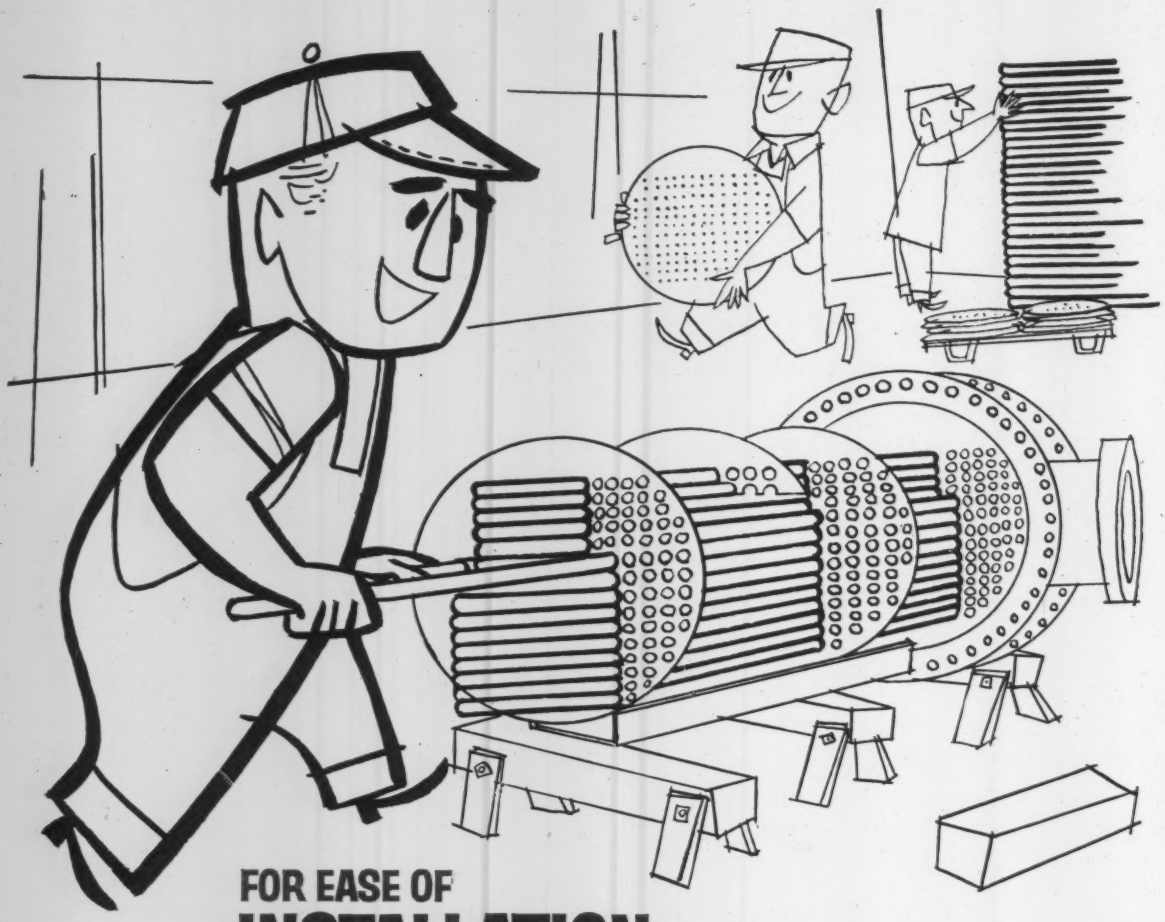

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B&W Job-Matched LECTROSONIC Heat Exchanger Tubing is available through a nationwide network of district sales offices and Steel Service Centers. And remember—matching tubes to jobs assures you the *right tube*, in the *right quantity*, at the *right time*. For more information, call your local B&W District Sales Office, or write for Bulletin T-431. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

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TUBULAR PRODUCTS DIVISION

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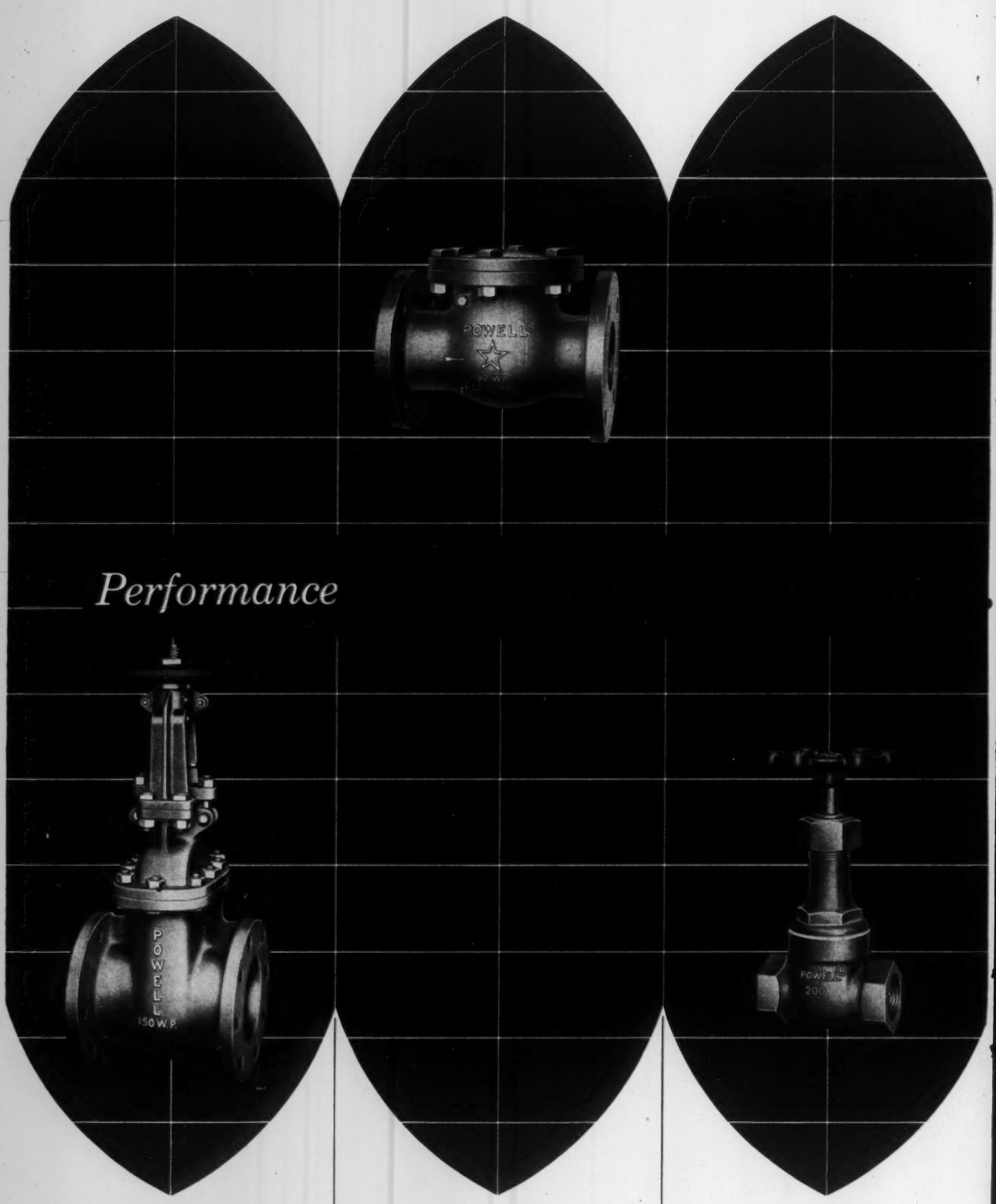
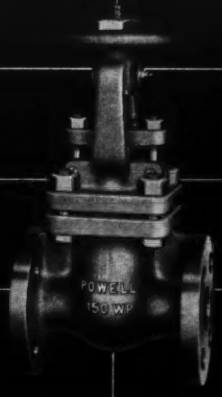


Performance

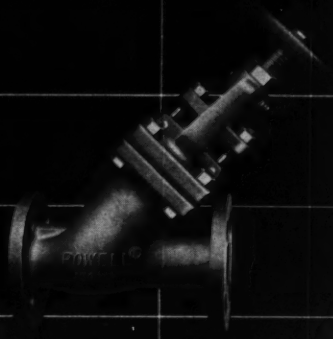
Fig. 2453SG—Large Stainless Steel Gate Valve for 150 pounds W.P. at 500F. Bolted flanged bonnet. Outside screw rising stem and yoke. Interchangeable, fully guided solid or split wedge discs.

Fig. 2433SS—Large Stainless Steel Swing Check Valve for 150 pounds W.P. at 500F. Bolted flanged cap. Flanged ends. Full unobstructed flow through when wide open.

Fig. 1832—Stainless Steel Gate Valve for 200 pounds W.P. at 500F. Screwed-in bonnet. Inside screw rising stem. Interchangeable, fully guided solid or split wedge discs.



Corrosion-Resistant



Powell Corrosion-Resistant Valves are expressly designed and made to control the flow of acids, alkalies, organic solvents, gases and many other corrosive fluids. Today—in chemical and process plants everywhere they are giving long, unfailing service combatting corrosion, erosion, heat and wear.

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So—your industry's fluid handling problem—no matter how tough—can be solved with the right Powell Valve. Ask your Powell Valve distributor (there's one in all major cities) for complete information and literature, or write directly to us.

*Registered trade name of The International Nickel Company.

†Registered trade name of The Haynes Stellite Company.

Fig. 2491—Stainless Steel Gate Valve for 150 pounds at 500F. Bolted flanged bonnet. Outside screw rising stem and yoke. Fully guided solid or split wedge discs.

Fig. 2107—Stainless Steel "Y" Valve for 150 pounds W.P. at 500F. Bolted flanged bonnet. Outside screw rising stem and yoke. Also available with screwed or socket welding ends.

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world's largest family of **valves**

THE WM. POWELL COMPANY
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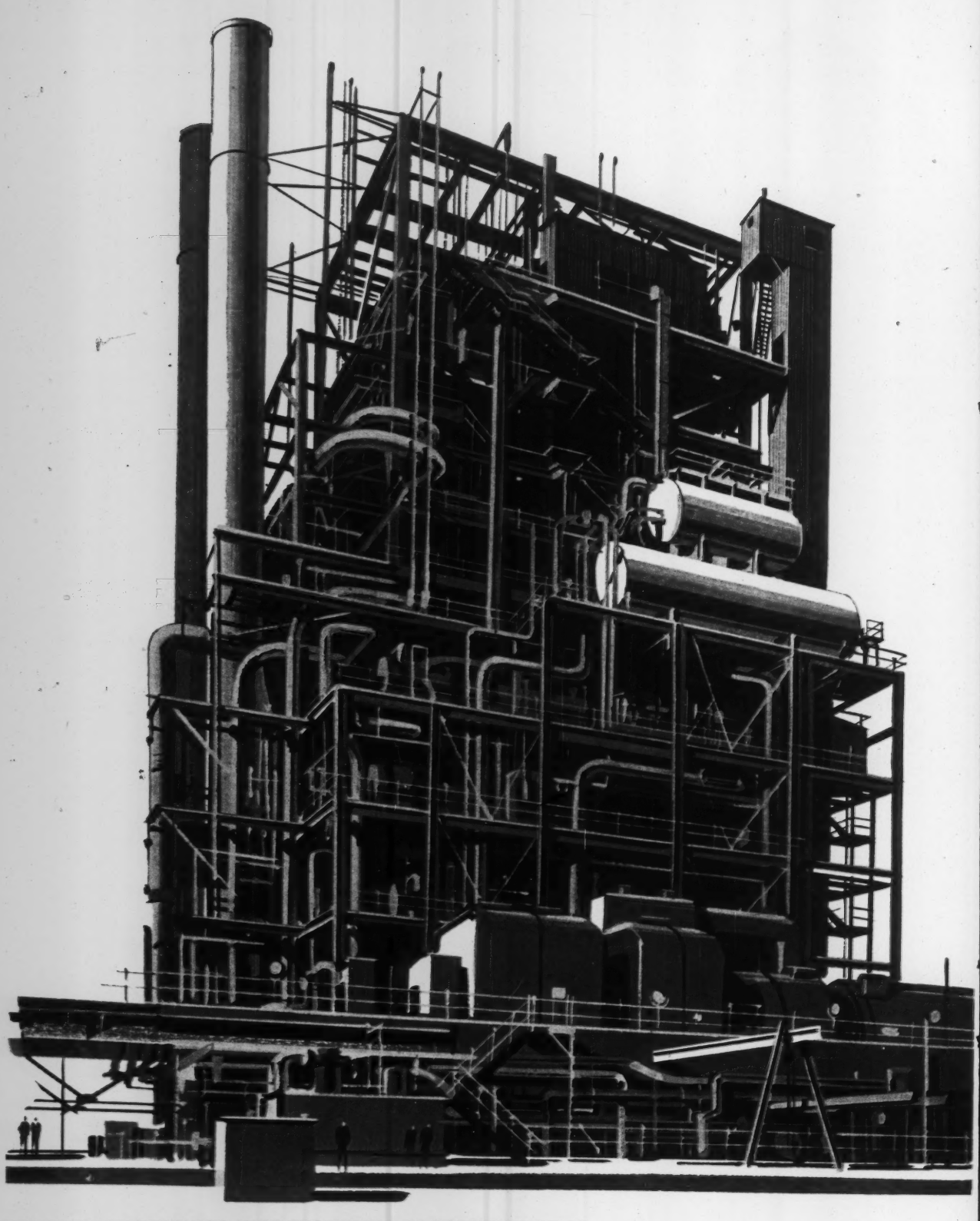

POWER PLANT PRODUCTS HEAT ENGINEERED BY FOSTER WHEELER:

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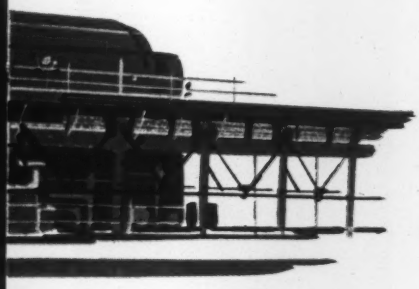

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NEW...FROM

TUBE-TURN *Bellows Expansion Joints are test rated on basis of minimum cyclic life.*

TUBE TURNS...

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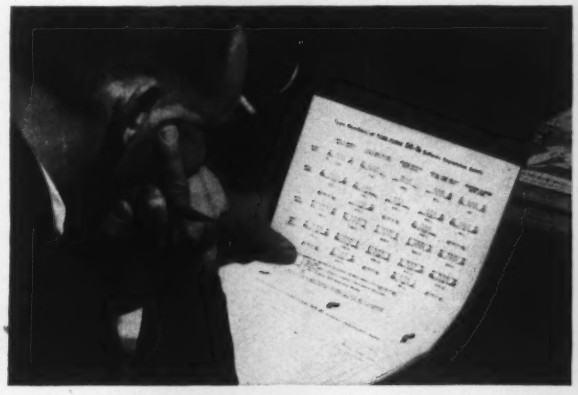
Tube Turns has introduced a brand new concept in bellows expansion joints to fill a vital need in engineered piping systems.

These new bellows joints are rated on the basis of thorough, well organized test studies to *assure a definite minimum cyclic life*... rather than the usual average or maximum. This conservative rating, backed by Tube Turns' extensive test results, gives you an assurance of *confidence* heretofore lacking in the application of bellows joints.



Hence, you can specify TUBE-TURN* Bellows Expansion Joints and be sure of predictable performance. These top-quality products will be subject to the same warranties that apply to all other products of Tube Turns.

Backed by Tube Turns' technical service! This new line of products is backed by 31 years of pioneering research in piping technology, including problems of piping flexibility. Our sales-engineering representatives, located nearby, will assist in the application of TUBE-TURN Bellows Expansion Joints to your specific problems.

Complete line. TUBE-TURN Bellows Expansion Joints are available in sizes 3″ through 30″... unreinforced, are rated as high as 75 psi in sizes 12″ and smaller... reinforced, are rated as high as 400 psi, in sizes 8″ and smaller. Adjusted pressure temperature ratings have been established for the full size range up to 800°F. Also, expansion compensators for steam and hot water service are available in sizes ¾″ through 2″. Mail coupon for complete information.

*The trademarks "TUBE-TURN" and "tt" are applicable only to the quality products of Tube Turns.

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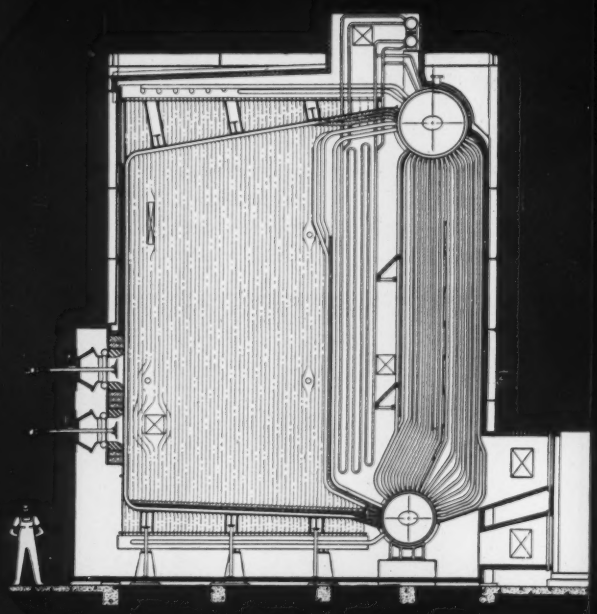
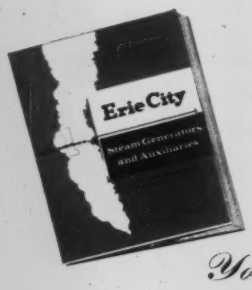
Erie City Multi-pass Pressurized 2-drum Steam Generators are quality designed and quality built for long life and low maintenance. These generators require forced draft only thereby eliminating the expense and maintenance of the usual additional induced draft equipment . . . also simplifies combustion control systems.

The Erie City Pressurized 2-drum Steam Generator features a welded **inner** seal casing and a welded **outer** casing — **each independent of the other.** The welded inner seal casing is attached to the pressure parts of the unit and expands and contracts as the unit breathes. The outer casing is attached to the structural steel supporting members and remains rigid. The use of properly designed expansion joints allows the pressure vessel and the inner casing to expand and contract in unison with no effect on the outer casing and structural members.

We invite comparison to the Erie City Pressurized 2-drum Steam Generator. Why don't you invite an Erie City Engineer to point out the many advantages of our unique design?





Available for your study of Erie City Steam Generators and Auxiliaries is catalog SB-6103-M

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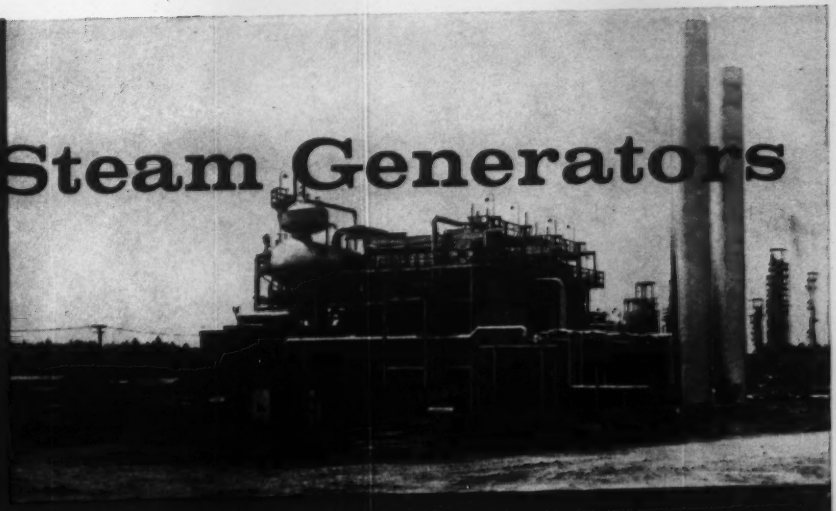
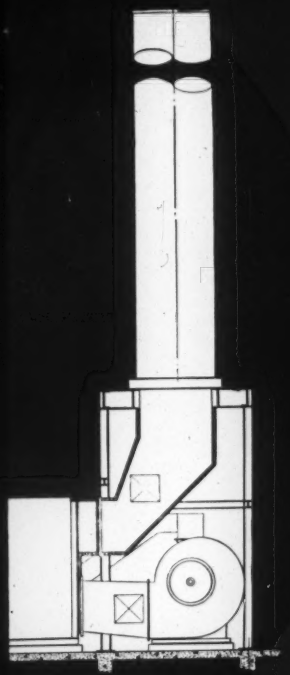
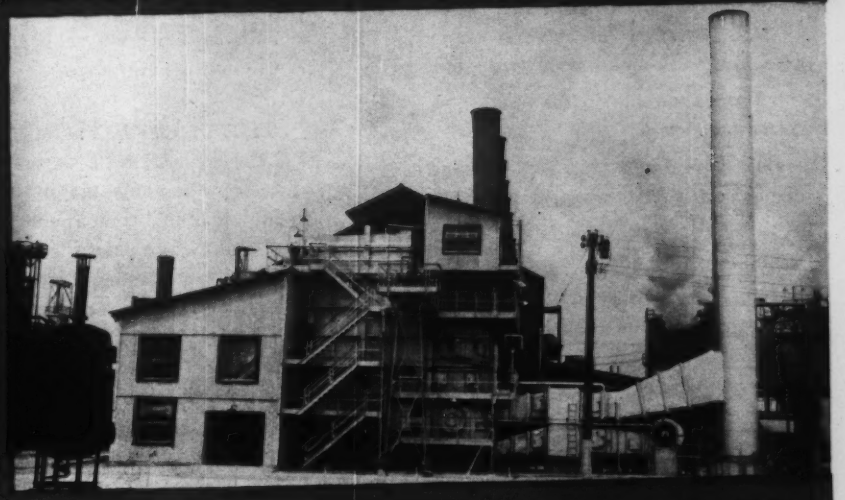
—2-drum Steam Generators



West Coast Oil Refinery with two 925,000 lbs./hr. pressurized [illegible] 700° F. steam temperature — gas and oil fired.



An Oklahoma Municipality has one 150,000 lbs./hr. pressurized unit designed for [illegible] lbs. pressure and [illegible] F. steam temperature — gas and oil fired.



In Illinois a petroleum refinery uses one 150,000 lbs./hr. pressurized generator — [illegible] lbs. design [illegible] — gas and oil fired.

Pipe being ultrasonically tested as required by Military Specification MIL-T-18063A (Ships).

SIZE RANGE

Diameter 2" through 32" O.D.
Wall 1/8" to 4"
Length up to 22 feet
Types of Stainless:
Austenitic grades, including E.L.C.

again "HYDROFORGED" fine-grain stainless piping specified for U.S. NUCLEAR NAVY

—INSTALLED IN NEW U.S.S. ENTERPRISE

U.S. NAVY SERVICE APPLICATIONS INCLUDE: Pipe for valve operating system reservoirs and primary water preheaters.

Primary coolant piping for nuclear submarines and surface ships.

Seamless welding fitting stock for large diameter reactor piping systems for submarines and surface ships.

Demineralizer shells.

Operating conditions in these services are in the range of 700° F. and 2,500 PSI.

THE PROCESS: The starting point is a high quality machined hollow billet, made centrifugally, which is cold expanded by hydrostatic pressures up to 50,000 PSI in specially designed massive metal dies. After "hydroforging," the pipe is given a recrystallizing anneal which results in the grain refinement characteristic of wrought stainless steel.

THE PRODUCT: After final machining of the O.D. and I.D. surfaces to 125 microinch finish, the pipe is subjected to all the testing requirements of Military Specification MIL-T-18063A (Ships) which covers seamless austenitic steel tubes and pipe intended for radioactive system services. This specification includes: chemical analysis, tensile properties (for Type 304 stainless steel—75,000 PSI minimum tensile strength, 30,000 PSI minimum yield strength, 35% minimum elongation), expanding and flattening tests, hydrostatic pressure test, intergranular corrosion test, macro-etch, ultrasonic and liquid penetrant examination.

The U.S.S. Enterprise, our first nuclear-powered super aircraft carrier, can cruise at great speed and for almost unlimited time and distances without refueling. The Enterprise, built by Newport News Shipbuilding and Dry Dock Co., ushers in a new age of mobility and power for air and surface warfare at sea. At left, the Skipjack, nuclear-powered and with revolutionary blimp-shaped hull, is the fastest of the A-Subs. Both vessels utilize hydroforged fine-grain stainless pipe supplied by United States Pipe and Foundry Company.

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Steel and Tubes Division

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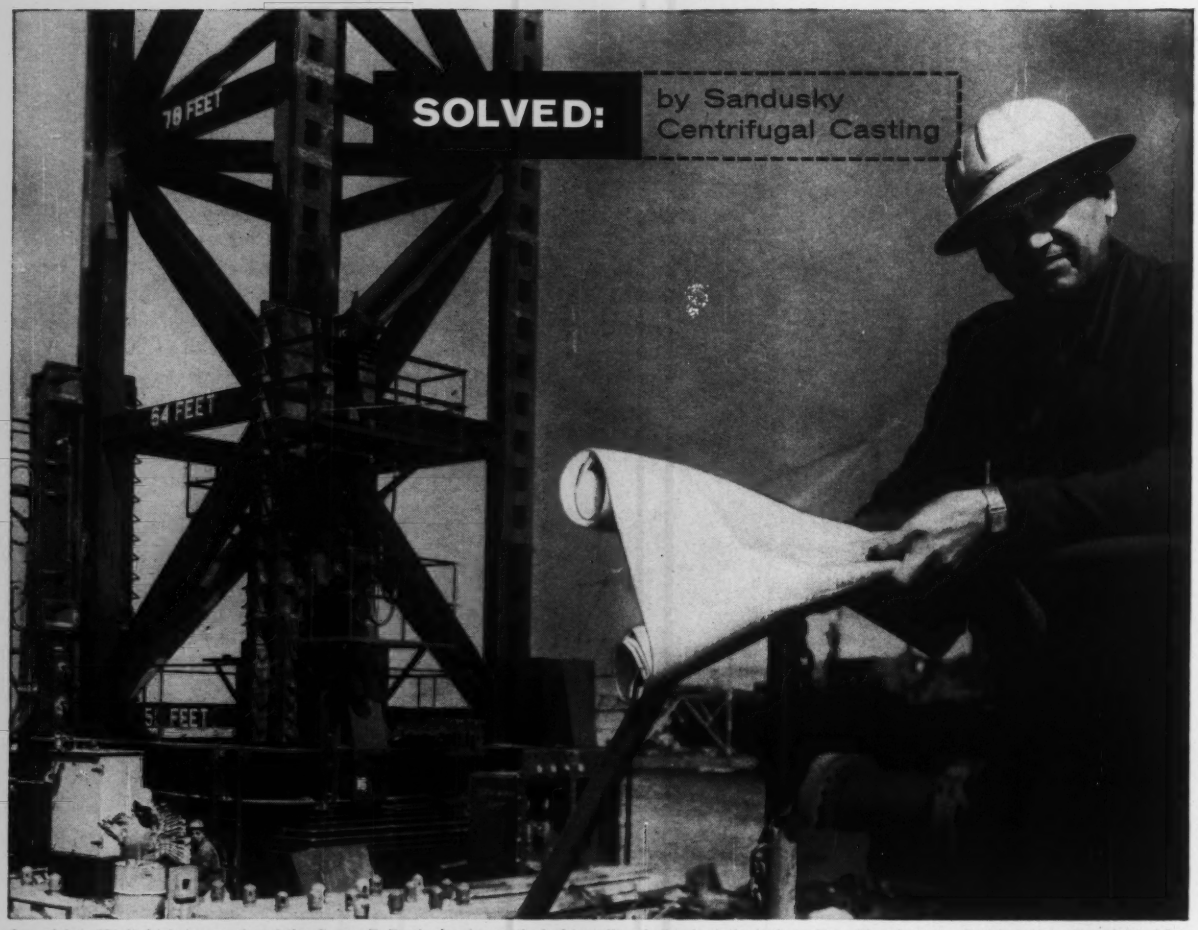


One of four 274 ft. high towers aboard the *George F. Ferris* showing method of installing hydraulic jacks built by Yuba Manufacturing Division, Yuba Consolidated Industries, Benicia, Calif. George Bauer, of Delong Corp., New York, is shown supervising construction while platform is being completed at Yuba's Richmond, Calif., plant.

YUBA gets quality-cost-delivery advantages by specifying 16 Sandusky cylinders

Sixteen 500-ton hydraulic jacks built by Yuba, for which Sandusky supplied the main cylindrical bodies, enable the new pipe-laying barge, *George F. Ferris,* to operate in waters 200 ft. deep!

This 5400-ton barge is equipped with four structural steel towers 274 ft. high. Four jacks on each of the towers provide the power to lower these steel "legs" to the ocean floor, raise the barge above the surface of the water, or retract the towers to render the barge navigable. The steel jack cylinders are Sandusky Centrifugal Castings, made to the requirements of ASME Code-approved SA-217, Section VIII, Unfired Pressure Vessels, to withstand operating pressures of 3000 psi. They were produced in 186" lengths, machined to 24" O.D. with 2" thick walls and sectioned into four pieces 43" long.

Yuba's selection of Sandusky Centrifugal Castings was based largely on three essential factors: QUALITY—meeting the exacting Code requirements . . . COST—saving about half the cost of an alternate method of manufacture . . . and DELIVERY—coming through on a tough time schedule by delivering all 16 cylinders within 21 working days!

When you need cylinders from 7" to 54" in O.D. and up to 33 feet long it will pay you to get in touch with us. Write for our latest booklet, *Your Solution To Cylindrical Problems* containing data on more than 70 ferrous and non-ferrous alloys.

SANDUSKY CENTRIFUGAL CASTINGS
FOUNDRY & MACHINE CO.

5902

SANDUSKY, OHIO—Stainless, Carbon, Low-Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys

BOILERS TO GO!

Delivered to the installation site by rail, truck or boat, shop-assembled Vogt Package Water Tube Boilers can be quickly placed in operation. After being placed from the carrier onto a simple low-cost concrete slab, a Vogt unit requires only piping, electrical and stack connections to go to work.

Little space is required because of their compact design and integrated firing equipment and controls.

A pressure type steel casing permits outdoor operation, if desired, eliminating the need for an expensive building.

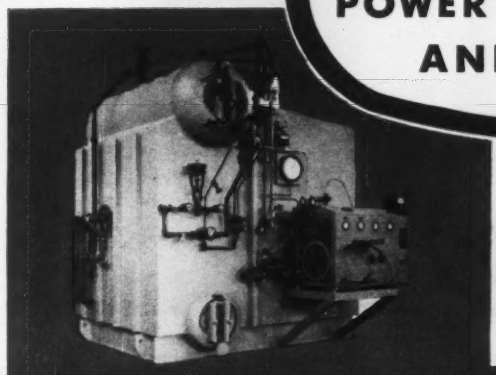
Write for literature. Address Dept. 24A-BM

Vogt

PACKAGED BOILERS

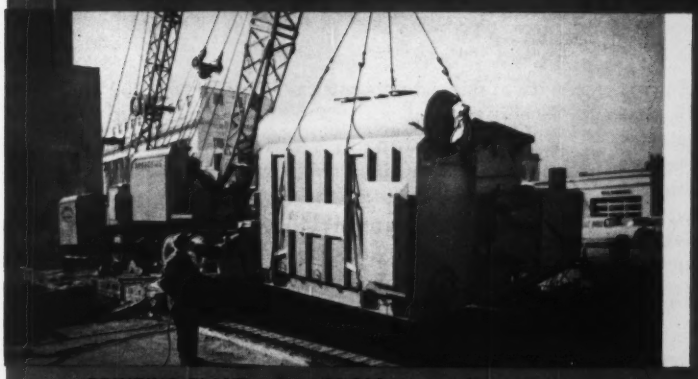
Shop Assembled for

POWER • PROCESSING AND HEATING

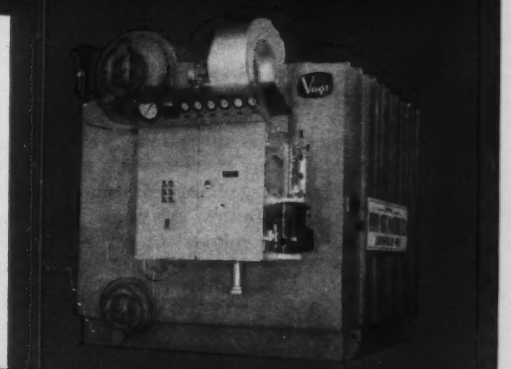


BOX PLANT — A 10,000 pounds/hour unit

HOSPITAL — Two 30,000 pounds/hour units



PRINTING PLANT — Two 20,000 pounds/hour units



OIL COMPANY — A 15,000 pounds/hour unit

For Direct Long Distance to Louisville dial 502 ME 4-9417

Package Unit Bulletin PSG-3 available on request

HENRY VOGT MACHINE CO.
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SALES OFFICES: Camden, N. J., Charleston, W. Va., Chicago, Cleveland, Dallas, Los Angeles, New York, St. Louis.

Now...new from Bailey

...a "foolproof"

FLAME DETECTOR

that rejects flames from other burners

Flame detectors are sometimes "fooled" by glowing refractories or flames from burners adjacent to that under surveillance. This new Bailey Flame Detector *responds only to the flame it surveys* . . . assures positive monitoring of coal, gas, oil or combination fuel-fired furnaces. Absence or failure of flame is sensed and accurately signaled—or relayed to control auxiliaries—without use of external relays or amplifiers.

Here are other distinctive features that make this new Bailey Flame Detector outstanding:

Wide temperature range . . . is suitable for use in areas with ambient temperatures from −20 to +300° F. Flame sensing element withstands temperatures up to 600° F.

Easy inspection . . . quick disconnect, keyhole mounting simplifies checking of lens condition and detector alignment.

Simple, solid-state circuitry . . . Bailey Flame Detector unit contains only 8 components.

Weatherproof construction . . . design of Bailey unit makes it suitable for outdoor installation.

Why not have your Bailey Engineer give you more information? Call the Bailey district office, or write us.

A147-1

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Instruments and controls for power and process

BAILEY METER COMPANY

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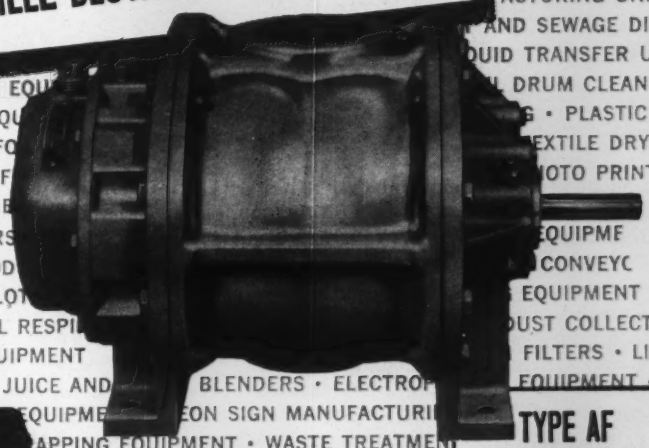
In Canada—Bailey Meter Company Limited, Montreal

Wherever air and gas are moved, you can rely on

ROOTS-CONNERSVILLE BLOWERS & GAS PUMPS

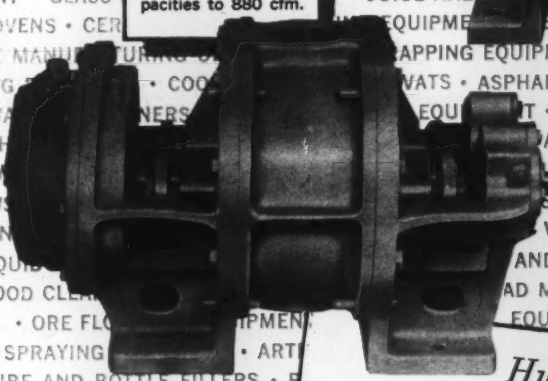


TYPE XA GAS PUMPS

18 sizes for pressures to 6 psig; capacities to 880 cfm.

TYPE AF BLOWERS

18 sizes for pressures to 10 psig; capacities to 920 cfm. Available in vertical and horizontal construction.



Hundreds of manufacturers

stake their product reputations on the dependability and durability of Roots-Connersville rotary positive blowers and gas pumps. Why? The "Roots" principle of rotary positive displacement provides: 1) controlled volume accuracy, 2) long life and low maintenance because of frictionless operation, 3) oil-free air because no internal lubrication is required, 4) flexibility because they adapt to any type of drive, plus 5) dependable Roots-Connersville technical service before and *after* installation.

Most major companies and hundreds of smaller ones find Roots-Connersville blowers and gas pumps obvious choices for both pressure and vacuum applications.

For full information about these small-capacity units, write for Bulletins AF-XA-360, AF-258 and XA-458.

The only manufacturer providing a full selection of rotary positive, centrifugal and Spiraxial® designs in air and gas handling equipment—

ROOTS-CONNERSVILLE BLOWER

DIVISION OF DRESSER INDUSTRIES, INC.

1260 Michigan Ave., Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto

See why ALCOA ALUMINUM makes good designs better

Requirement: achieve these major process equipment design aims: minimize product contamination . . . lengthen equipment life without adding maintenance costs . . . keep first cost down.

Key to Good Design: Alcoa Aluminum to eliminate contaminants, improve corrosion resistance, deliver strength without extra weight for design economies—at low first cost.

The evolution of process equipment design has developed a significant trend toward the use of aluminum—Alcoa® Aluminum—to satisfy increasingly stringent requirements of modern processing. At the base of this trend has been one factor: a growing awareness that aluminum provides a combination of chemical and physical properties perfectly suited to the needs of a particular process and the equipment which contains it.

Take, for example, the needs of a low pressure polyethylene process such as the one diagrammed below. The primary need here is for equipment which will not impart contaminants which discolor the product. The obvious design answer is aluminum with its demonstrated ability to prevent such contamination. Add to this such other important aluminum design benefits as these:

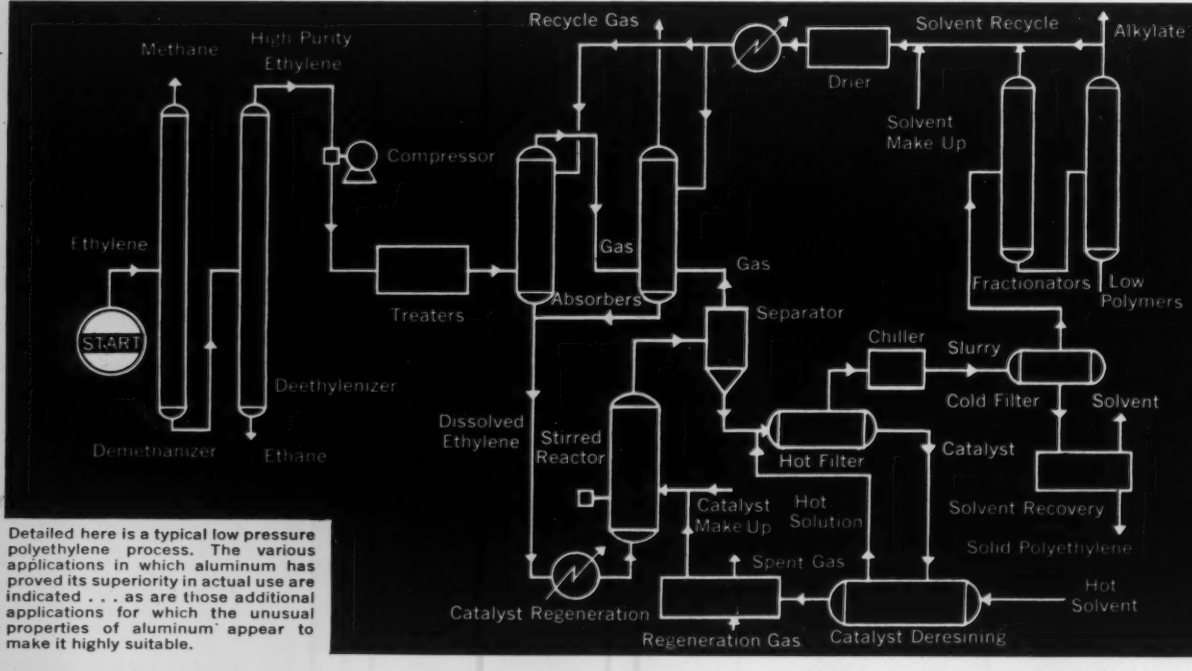
It provides a level of corrosion resistance unique among commonly used metals; its low temperature properties are outstanding (tensile and yield strengths actually increase without embrittlement as operating temperatures drop); it is nontoxic; its strength-weight ratio surpasses that of nearly every other metal; and its first cost is far lower than that of other suitable materials.

To take advantage of this unusual range of characteristics, designers and builders of polyolefin plants have employed Alcoa Aluminum in such varied equipment applications as heat exchangers, dryers, cyclone bins, cube storage bins, piping and a host of others.

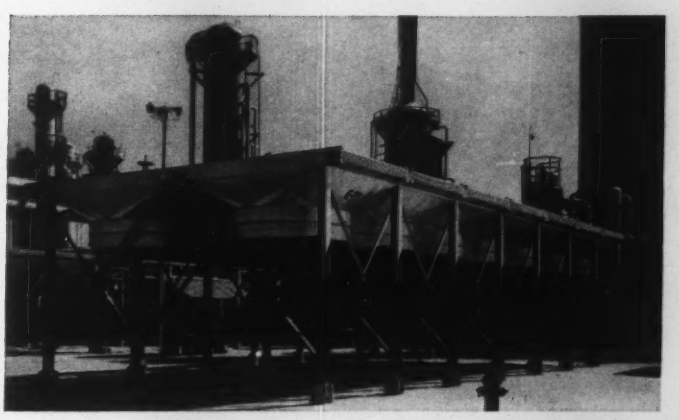
And polyethylene represents just one of literally hundreds of processes in which aluminum provides important design benefits on equipment applications of nearly every type. A few of these are shown on the opposite page. In nearly every case, aluminum's benefits can be predicted with surprising accuracy—thanks to the large volume of factual service data developed by Alcoa in well over 40 years of applying aluminum to process equipment requirements. Alcoa engineers are anxious to share this experience with you. They are doing so through a series of engineering conferences being held this year in major cities throughout the country. Your local Alcoa sales office will furnish you with details.

Examine the large body of Alcoa technical literature which describes in detail the proven performance characteristics of aluminum in a variety of process industries uses. Simply fill in and mail the coupon opposite.

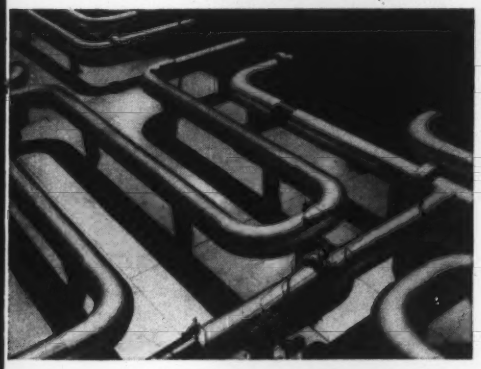
World-wide sales through ALCOA INTERNATIONAL, INC., 230 Park Avenue, New York 17, N.Y.



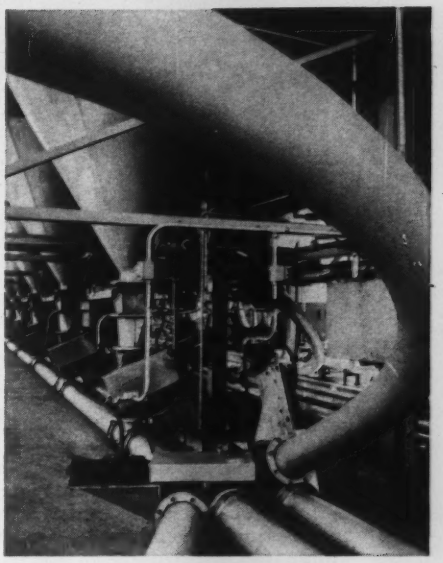
Detailed here is a typical low pressure polyethylene process. The various applications in which aluminum has proved its superiority in actual use are indicated . . . as are those additional applications for which the unusual properties of aluminum appear to make it highly suitable.



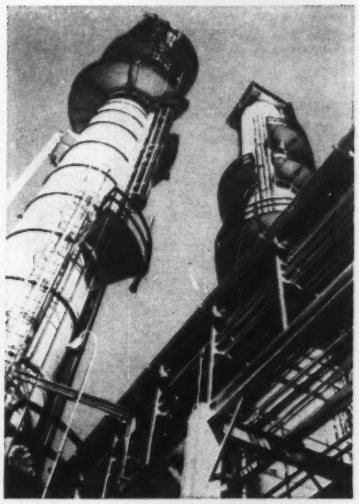
Below, aluminum's ability to maintain its serviceability and excellent appearance in chemically contaminated atmospheres is utilized here in Al-Cor-Jac alclad aluminum jacketing—manufactured by Insul-Coustic Corporation, Maspeth, Long Island, N.Y.



Pictured above is a Solo-aire cooling unit manufactured by Hudson Engineering Corporation, Houston, Texas. Here the excellent heat transfer properties of aluminum made it a natural choice for process cooling. Of important added value are the excellent corrosion resistance of aluminum and its outstanding low temperature properties.



Right, this polyethylene process employs a variety of aluminum applications to prevent product discoloration. Since the process operates at extremely low temperatures, aluminum's excellent low temperature durability is an important asset in piping, bins, hoppers and vessels.



These prilling towers and nearly all of the piping and equipment surrounding them are aluminum. Selection of Alcoa Aluminum was based upon the metal's unique ability to withstand corrosive attack in this nitrogen fertilizer operation — plus its excellent strength-weight ratio which contributes to economical design by eliminating the need for excessive structural support.

For exciting drama watch
"Alcoa Presents"
every Tuesday—ABC-TV

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Aluminum Company of America, 866-M Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries:

- ☐ 10197 Aluminum Pipe and Fittings
- ☐ 10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ 514 Alcoa Duotrace Technical Report
- ☐ 10270 Alcoa Utilitube
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 11453 Solving Refinery Corrosion Problems with Aluminum
- ☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
- ☐ 19416 Brazing Alcoa Aluminum
- ☐ 19415 Welding Alcoa Aluminum
- ☐ 19051 Alcoa Aluminum Handbook

Name.....

Company.....

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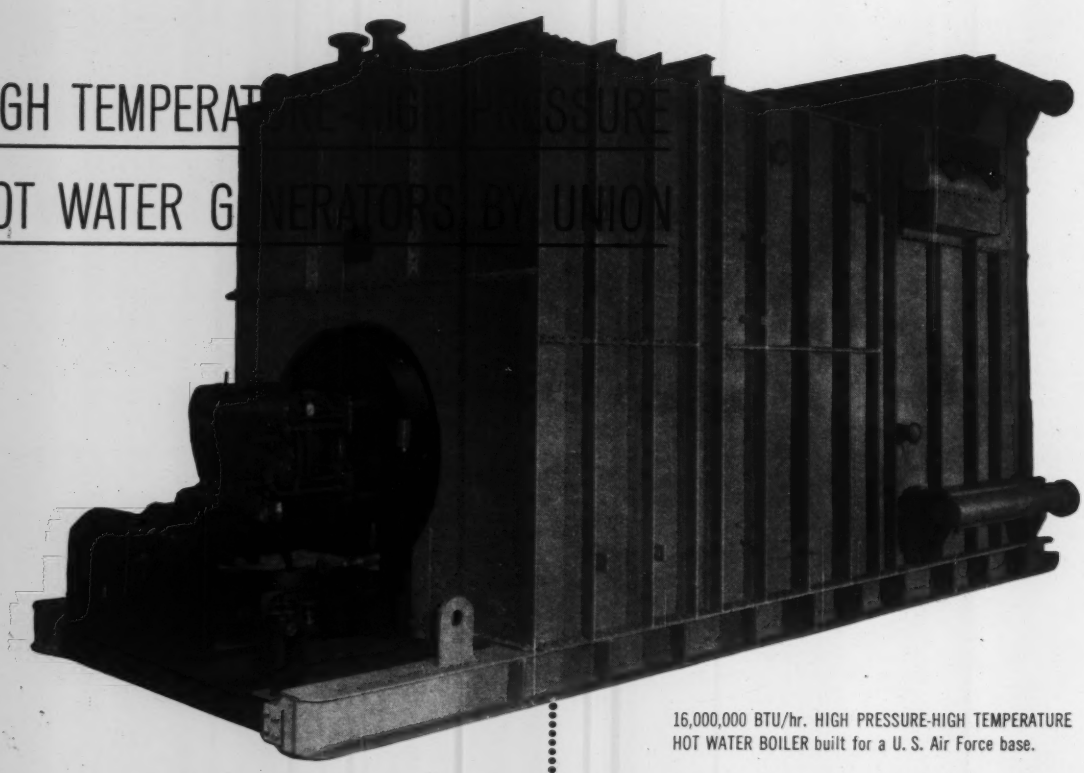
HIGH TEMPERA[illegible]

HOT WATER G[illegible]



16,000,000 BTU/hr. HIGH PRESSURE-HIGH TEMPERATURE HOT WATER BOILER built for a U. S. Air Force base.

SHOP ASSEMBLED UNITS INSTALLED WITHOUT COSTLY FIELD BALANCING

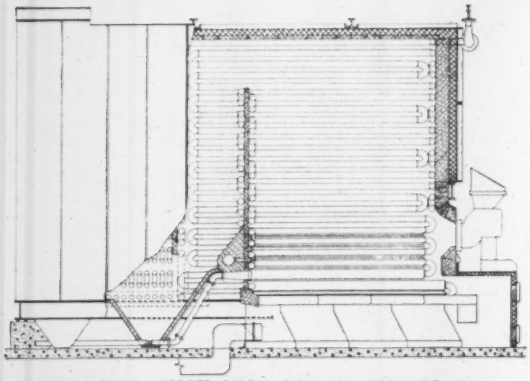
Right from the start, you can save with a Union shop assembled HTHP Hot Water Generator. With all of its circuits of the same hydraulic length, time consuming field balancing can be eliminated. Most units do not require orifices or any other mechanical adjustments to equalize flow at the time of installation.

High water velocities (above 5 ft./sec.) and liberally proportioned, water cooled furnaces eliminate localized overheating. As there are no multi-tube circuits in the radiant section, recirculation within a circuit is impossible, thereby eliminating vapor binding or stagnant flow areas.

Liquid and gas flow run counter to each other. With the liquid inlet positioned at the top of the convection section, the lowest temperature liquid is served by the lowest temperature gas. As a result, generator efficiency is improved and the risk of thermal shock minimized.

Standard units (both shop assembled and field erected) can be modified to meet a wide range of job requirements. They can be arranged for firing with most commercial fuels as well as waste fuels in liquid, gaseous or solid form.

For specific information, outline your requirements to a Union representative or contact Union Iron Works.



31,000,000 BTU/hr. FORCED CIRCULATION, HIGH PRESSURE-HIGH TEMPERATURE HOT WATER BOILER. Equipped for firing by an oscillating grate spreader stoker with fly ash reinjection. Fully factory-assembled for shipment.

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water tube steam generators and allied equipment

Maxitorq

Series 9000
electric clutches and brakes

an outstanding design feature of tape-controlled automatic turret lathes

Five Maxitorq Series 9000 Electric Clutches are used in the all-new Potter & Johnston No. 3E-15 Tape-Controlled Automatic Turret Lathe. Four are used in the headstock to provide automatic spindle speed changes and a fifth is used as a master clutch in the feed drive. These clutches of advanced design have PROVED their ability to assure consistent, positive and extremely fast action; essential to these machines. They transmit full load, are self-compensating for wear and permit great flexibility in control.

With operation induced entirely by magnetic flux, Maxitorq Series 9000 Electric Clutches are well adapted to a wide range of machine tool drives. They are simple and rugged in design, require no adjustments, can be used *either as a clutch or brake* and are built to American Machine Tool Standards. Disc separators not only separate discs, providing a drag-free neutral without heating, but also break up residual magnetism and permit extremely fast, positive action.

The 9000 Series Clutches have a minimum of moving parts and the electrical operating unit remains stationary, hence, there are no brushes, slip rings or complex wiring. Maxitorq Clutches operate on 110 V. A. C. rectified to 90 V. D. C. Other voltages on special order.

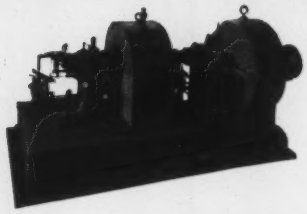
If you have a clutch or brake application where you are looking for new and improved performance, bring your problem to us.

Phone, wire or write Dept. ME for Series 9000 Bulletin.

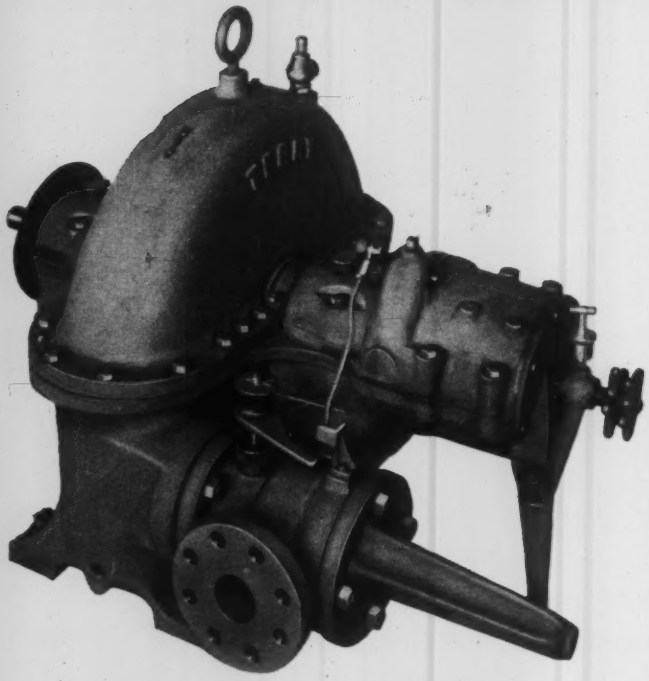
The Carlyle Johnson Machine Company, Manchester, Conn.

3CJ59

There's a Terry solid-wheel turbine for any mechanical-drive requirement



Solid-wheel turbo-geared unit rated 600 hp, 4000/650 rpm.



Standard solid-wheel turbine with constant-speed mechanical-type governor and hand speed changer.

The completeness of the Terry line of solid-wheel turbines enables you to choose an *ideal* drive for any application . . . choose the specific features you want from a wide variety of designs.

Standard turbines are made in capacities up to 2,500 hp, with either cast-iron or cast-steel casings. The standard wheel is carbon steel. Where operation is to be at high speed or at high temperature, wheels of forged alloy steel are used. Vertical and geared turbines are also available.

And you can select from a range of governors, including: constant speed, either mechanical or oil relay, and variable speed, either direct acting or oil relay. Excess-pressure or constant-pressure pump governors are also available. When required, remote speed control can be furnished for variable-speed governors.

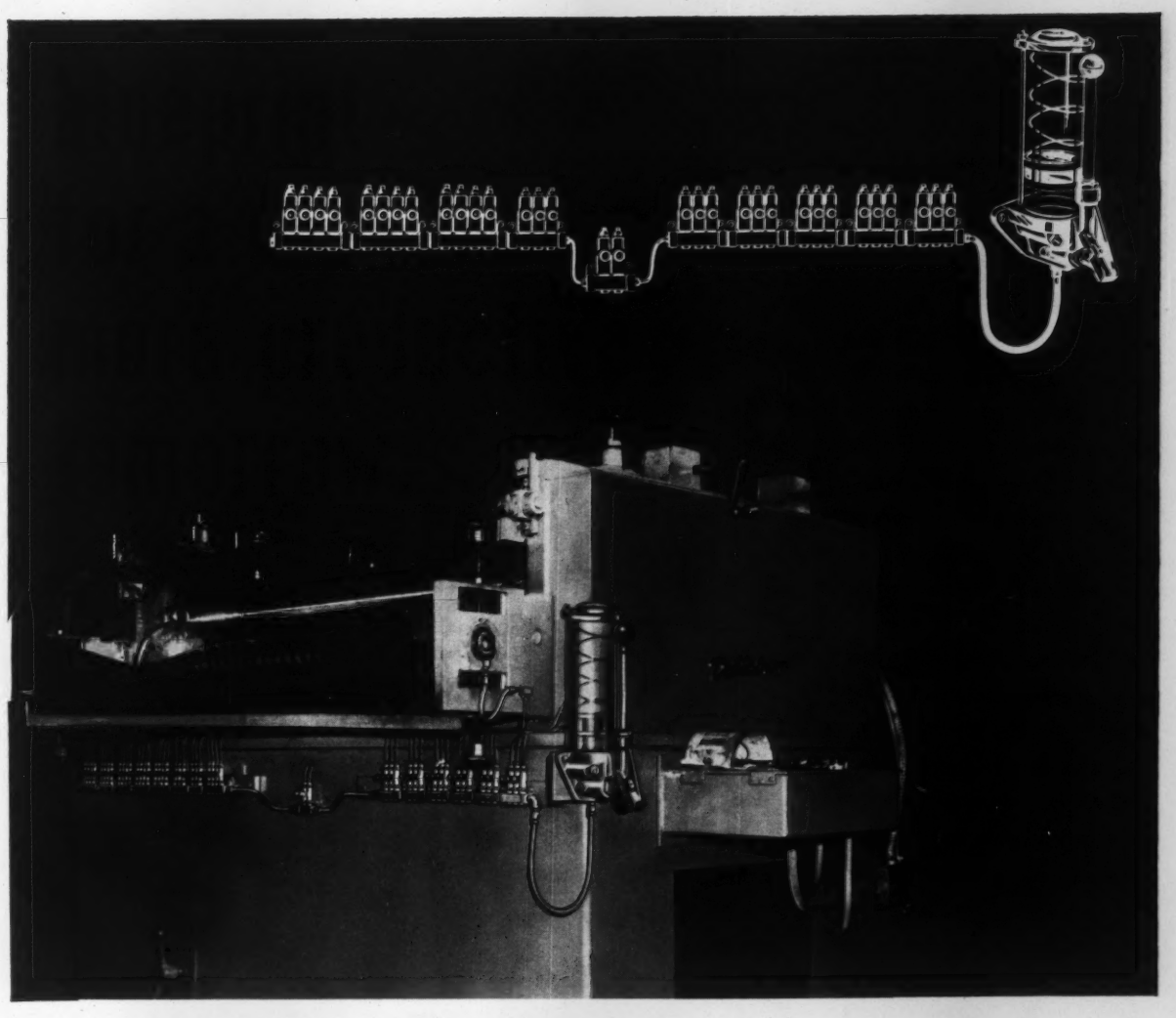
Tell us what your requirements are so we can send you full details of a turbine to meet your needs exactly. For general information, send for a copy of bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

Vertical turbines with the Terry solid wheel are available in capacities from 5 to 300 hp.

TT-1218



A *Lincoln* Centralized Lubrication System

In seconds a Lincoln Centralized Lubrication System lubricates all bearing surfaces while machinery is operating. It assures that every bearing gets the right amount of lubricant at the right time, whether you use the simpliest, manually-operated CentrOluber* or a completely automatic CentrOmatic* System. Centralized lubrication cuts downtime and bearing replacement, boosts plant efficiency and production.

Lincoln systems can be actuated by hand, reciprocating motion, air or electricity. There are 26 systems available to meet every lubricant application requirement . . . including *yours*. Mail the coupon today for complete details and specifications.

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Coast-to-Coast Sales and Service through 16 Branch Offices and Leading Industrial Distributors.

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Lincoln

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Division of The McNeil Machine & Engineering Co.
St. Louis 20, Missouri

LINCOLN ENGINEERING CO.
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Please send my complimentary copy of Catalog 81 on Lincoln Centralized Lubrication Systems.

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Company.....

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City.....Zone.....State.....

Here are the steam traps designed especially for heating systems . . .

ARMSTRONG OPEN FLOAT AND THERMOSTATIC STEAM TRAPS

Engineered for low pressure intermittent service where large amounts of air accumulate while steam is off

Armstrong O.F.&T. Traps make it possible for heating systems to deliver the efficiency they were designed to deliver. They are ideal for low pressure unit heaters, preheat and reheat coils, converters, hot water generators, etc.

Advantages to the user:

BIG AIR HANDLING CAPACITY—Thermic vent handles large amounts of air in system when steam is turned on. Fixed vent handles normal air in system.

NO STEAM LOSS—Stainless steel valve is water sealed, is not damaged by dirt or scale, cannot develop steam leaks.

CONDENSATE AND AIR REMOVED AT STEAM TEMPERATURE—No opening lag.

LONG LIFE—All working parts, including open float, are stainless steel. Bodies and caps designed for 250 psig operation. Open float cannot collapse.

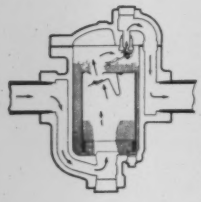
MINIMUM MAINTENANCE—Simple, proved design and high quality materials assure trouble-free service.

LOW COST—Mass production methods permit high quality at low cost.

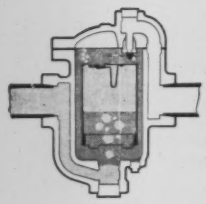
EASY INSTALLATION—Horizontal straight-through pipe connections, conventional sizes.

UNCONDITIONALLY GUARANTEED—All Armstrong Traps are guaranteed to satisfy the user or purchase price will be refunded.

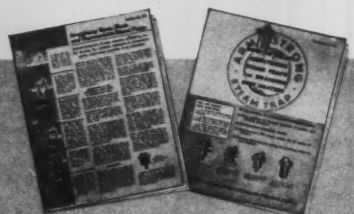
HOW ARMSTRONG O. F. & T. TRAPS WORK:



When steam is turned on, it pushes air through the wide open thermic vent and trap discharge valve at full differential pressure between supply and return lines. Condensate formed by incoming steam goes right through.



As steam reaches open float, thermostatic vent closes. Float fills with steam and rises to close trap valve. Residual air and CO_2 escape through fixed vent at steam temperature.



BULLETIN NO. 775 BULLETIN NO. 801

Use the coupon at right to get these helpful bulletins: No. 775 describes O.F.&T. traps fully. No. 801 tells how to select traps for draining unit heaters including data on 30 makes of unit heaters.

ARMSTRONG MACHINE WORKS
8946 Maple St. • Three Rivers, Mich.

Armstrong Machine Works
8946 Maple St., Three Rivers, Mich.

Please send me: ☐ O.F.&T. Trap Bulletin No. 775; ☐ Unit Heater Bulletin No. 801.

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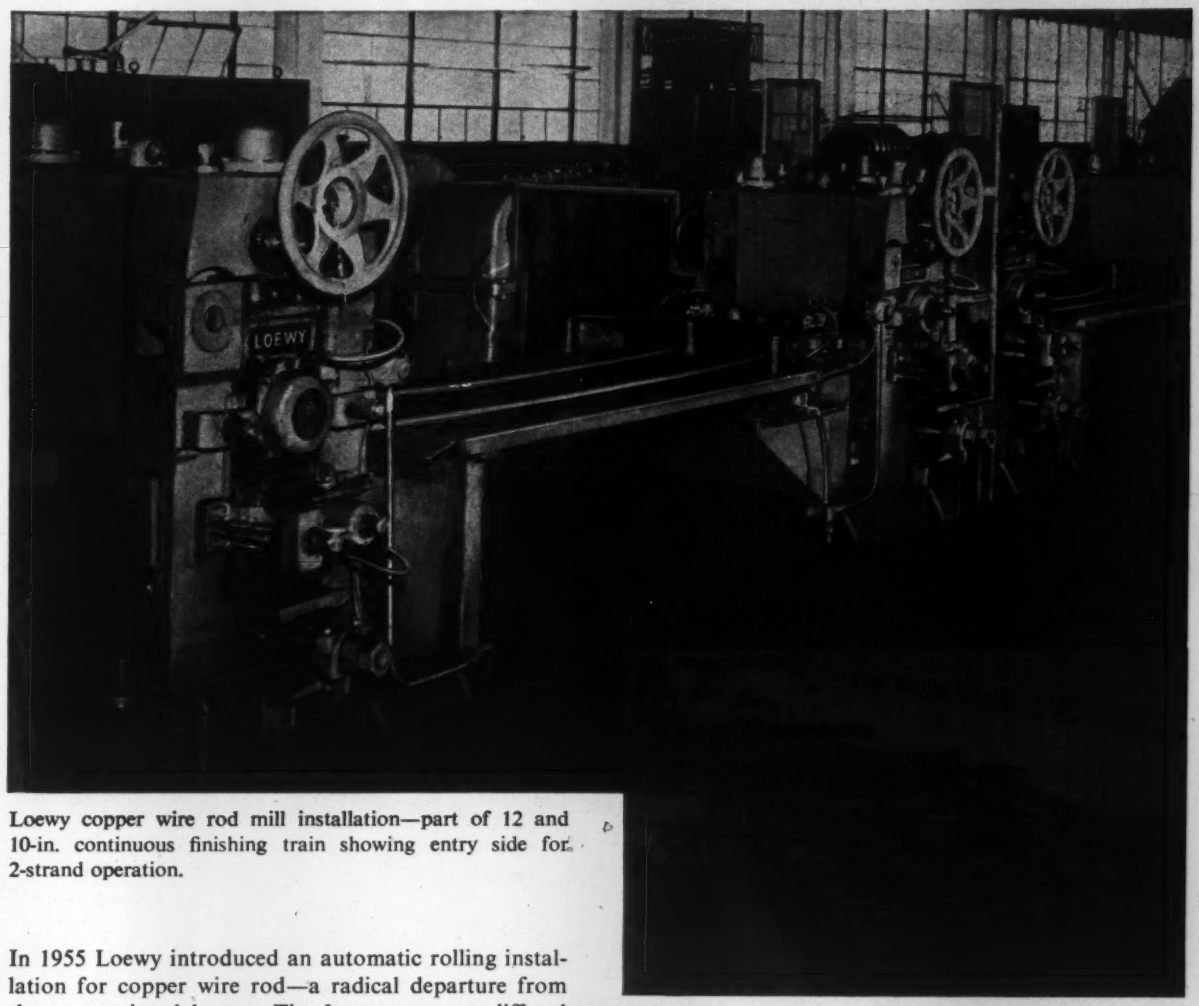
Company.....

Address.....

City.....Zone.....State.....

NOW! "LOEWY-COMPACT" MILLS for the economical production of copper wire rod



Loewy copper wire rod mill installation—part of 12 and 10-in. continuous finishing train showing entry side for 2-strand operation.

In 1955 Loewy introduced an automatic rolling installation for copper wire rod—a radical departure from the conventional layout. The Loewy concept differed fundamentally from the customary looping stand, which was serviced by tong men and required a considerable crew of highly skilled operators. Loewy has now taken another major stride.

The new "Loewy-Compact" mill features remarkable compactness and automation, optimum precision, and highly economical design. Heretofore it was considered uneconomical to roll smaller quantities of copper wire rod. The capital investment and the space requirements involved in a continuous wire rod mill seemed prohibitive for companies of limited size or those restricted in plant area.

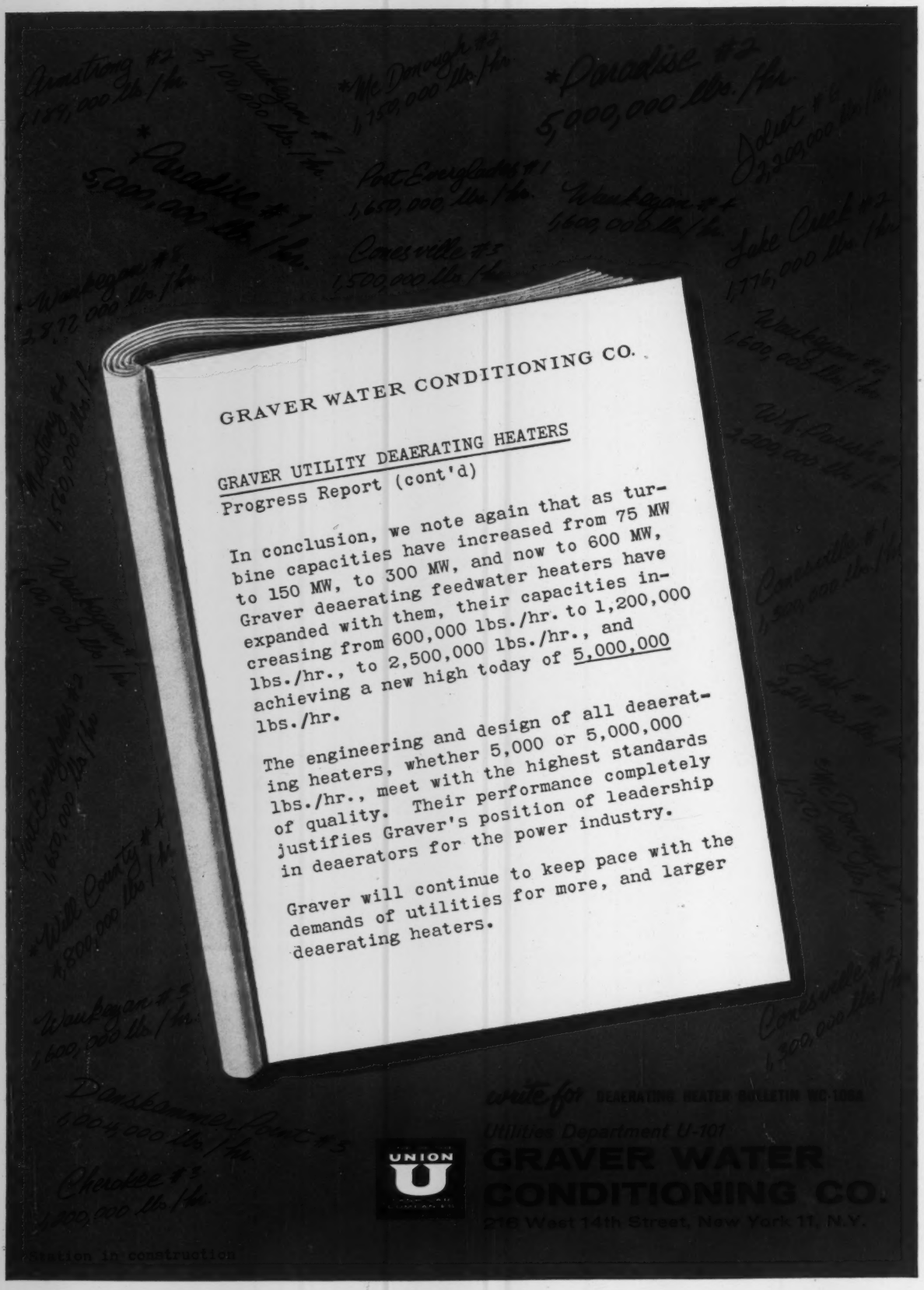
Overall view of 14-pass continuous Loewy wire rod mill

Studies have demonstrated that wire rod in smaller quantities can be profitably produced on this new Loewy wire rod mill.

Avail yourself of our services in order to hold your own in the competitive market. Write Dept. F-12, outlining your requirements.

BALDWIN · LIMA · HAMILTON

INDUSTRIAL EQUIPMENT DIVISION • PHILADELPHIA 42, PA.

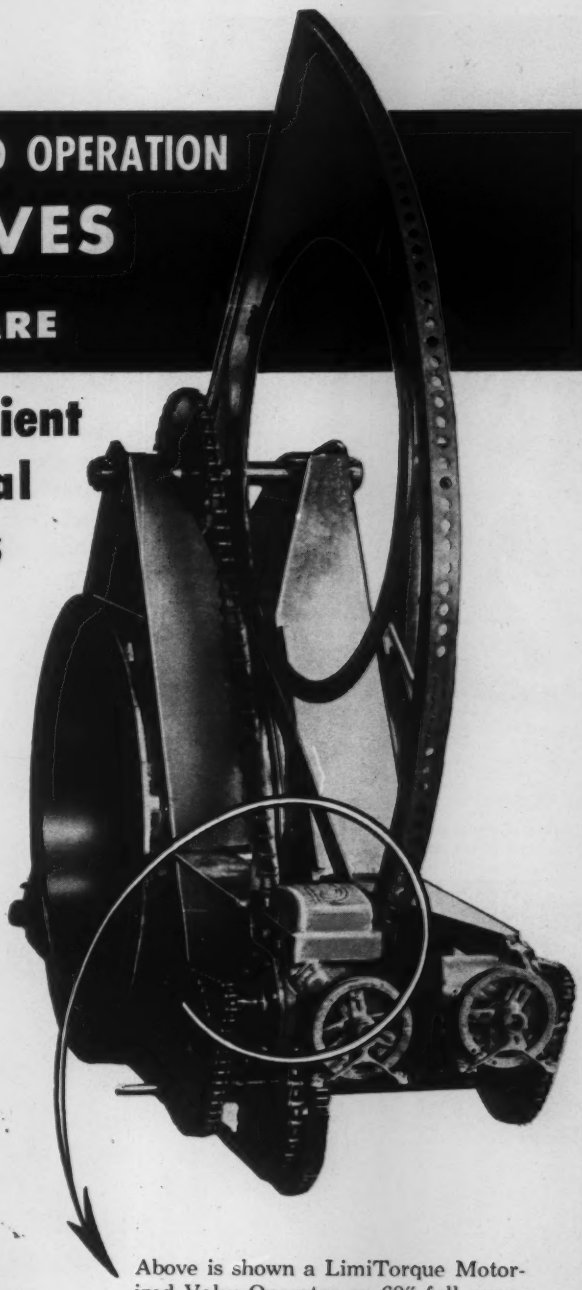

GRAVER WATER CONDITIONING CO.
GRAVER UTILITY DEAERATING HEATERS
Progress Report (cont'd)
In conclusion, we note again that as turbine capacities have increased from 75 MW to 150 MW, to 300 MW, and now to 600 MW, Graver deaerating feedwater heaters have expanded with them, their capacities increasing from 600,000 lbs./hr. to 1,200,000 lbs./hr., to 2,500,000 lbs./hr., and achieving a new high today of 5,000,000 lbs./hr.
The engineering and design of all deaerating heaters, whether 5,000 or 5,000,000 lbs./hr., meet with the highest standards of quality. Their performance completely justifies Graver's position of leadership in deaerators for the power industry.
Graver will continue to keep pace with the demands of utilities for more, and larger deaerating heaters.
write for DEAERATING HEATER BULLETIN WD-1058
Utilities Department U-101
UNION
GRAVER WATER CONDITIONING CO.
216 West 14th Street, New York 11, N.Y.

Push-Button MOTORIZED OPERATION *of* GOGGLE VALVES BY LimiTorque ARE

Faster, Safer, more Convenient and far more Economical than hand operated valves

LimiTorque Motorized Valve Operators on large Goggle Valves have proven of true value in many steel plants because of their quick, safe and positive cut-off of Blast Furnace, Coke Oven and other types of gases. The use of LimiTorque Operators also easily takes care of Goggle Valves in inaccessible locations; reduces exposure of operating personnel to toxic gases. Another point, operation of Goggle Valves with LimiTorque permits actuation by chain wheel, should there be a power failure at any time.

Write for Bulletin #1-60, which gives full details for LimiTorque Operation of Goggle Valves . . . use your Business Letterhead when requesting a copy.



Above is shown a LimiTorque Motorized Valve Operator on 60" full opening Brosius-Westling Goggle Valve recently installed in a Blast Furnace Gas Main, at a large Mid-Western Steel Plant.

THERE IS NO SUBSTITUTE FOR —

LimiTorque®

PHILADELPHIA GEAR CORPORATION

KING OF PRUSSIA (SUBURBAN PHILADELPHIA), PA

Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

Limitorque Corporation • King of Prussia, Penna.

Apron Conveyors—excellent for horizontal or inclined conveying.

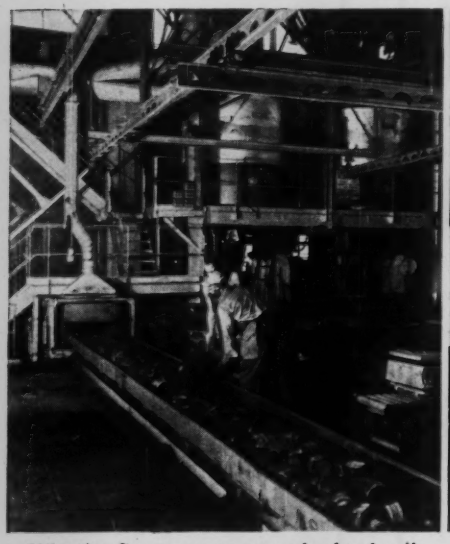
JEFFREY CONVEYORS TO MEET YOUR MATERIALS HANDLING NEEDS

COMPONENTS, ACCESSORIES FROM STOCK

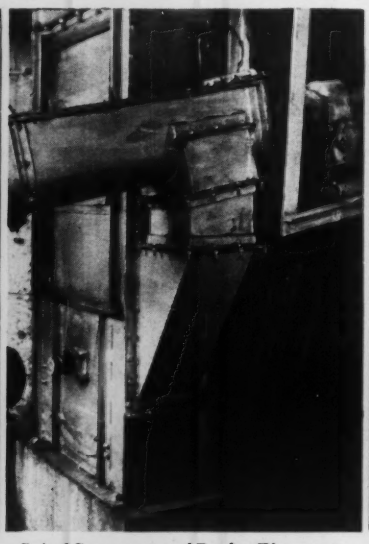
The plant engineer must treat every conveying job as a brand new project; the material to be moved has its own peculiar characteristics; distances, elevations and surroundings vary to affect operating conditions. Selecting a conveyor requires a thorough knowledge of the factors involved.

That's where Jeffrey's 75 years of materials-handling experience steps in to help. Based on this know-how, our engineers recommend the type of conveyor that will move the material most efficiently. They help plan it for maximum performance at most economical first cost; will even supervise installations.

Jeffrey conveying equipment maintains high production, lightens labor's burden and reduces operating costs. Send for data. The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.



Vibrating Conveyors—transport hard-to-handle materials easily.



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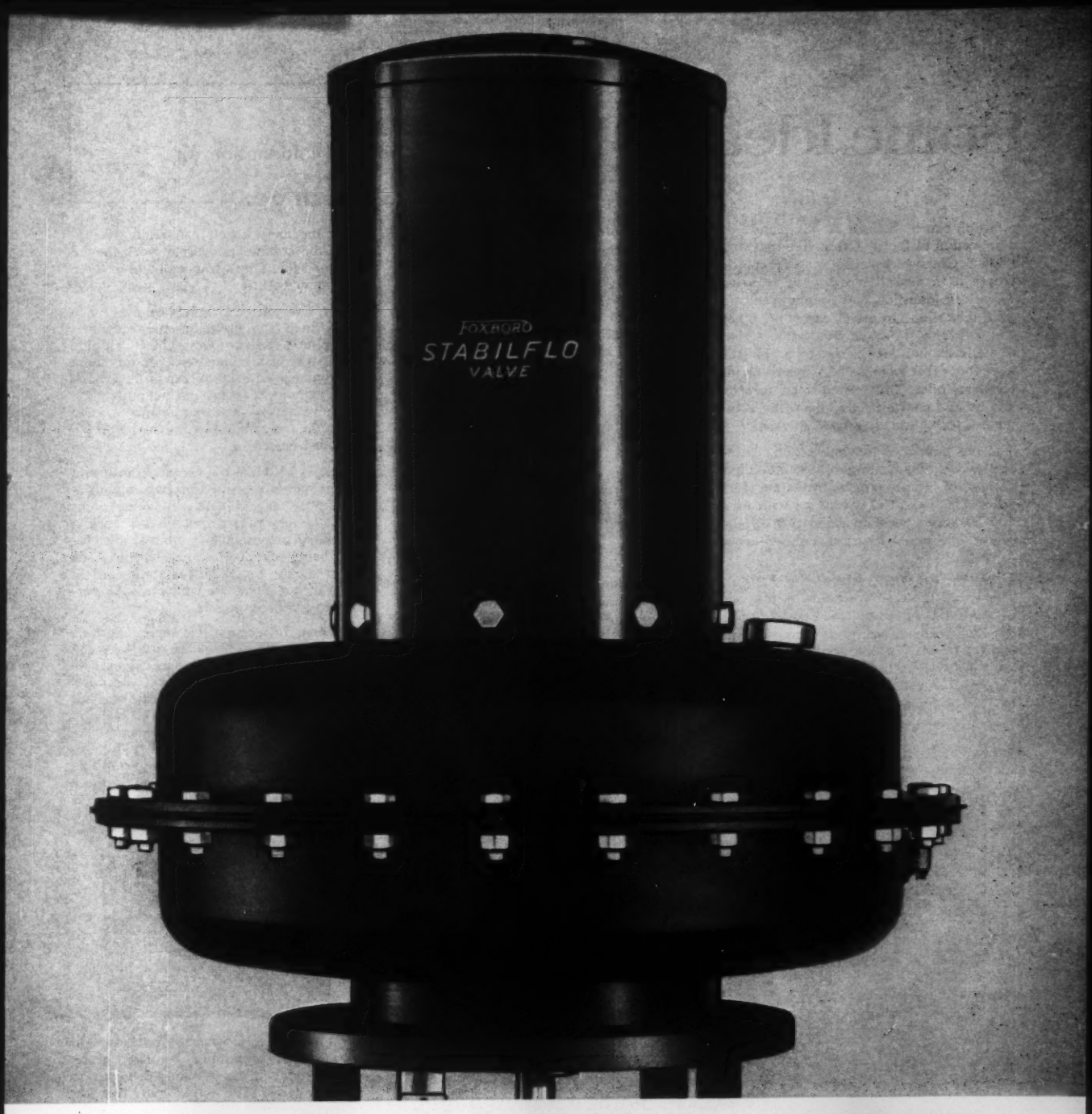

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1½ to 4-inch stroke — linear relationship between input signal and valve stem position . . . weatherproof construction . . . selection of air-to-lift or air-to-close action. You'll want to know more about this motor. Ask your nearby Foxboro Field Engineer for full details or write for Bulletin 5C-17. The Foxboro Company, 9612 Neponset Avenue, Foxboro, Mass. *Reg. U. S. Pat. Off.*

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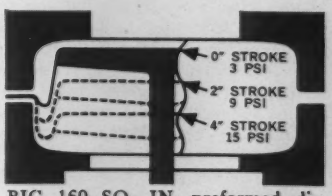

BIG 160 SQ. IN. preformed diaphragm maintains essentially constant effective area throughout the stroke. Result: a linear relationship between input signal and valve stem position — precise positioning of the stem for every signal change.

Some Ideas

for your file of practical information on graph papers

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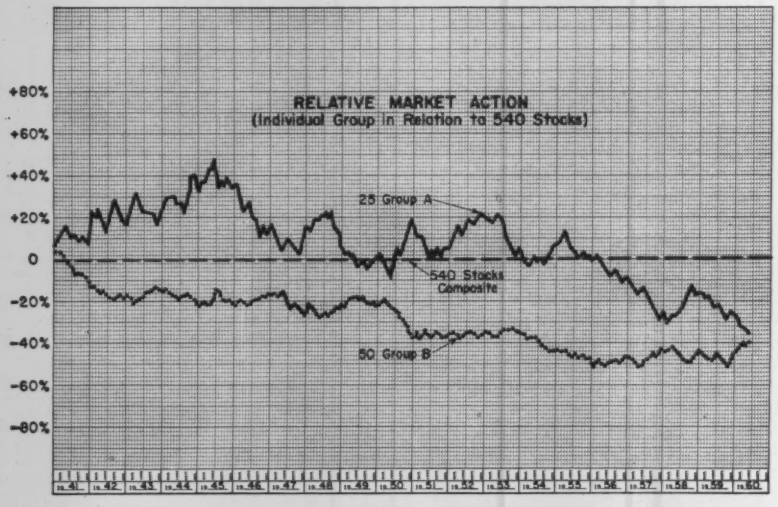

12,300 variables at a glance. Here's a typical stock market chart used to study relative market action. Center line is market behavior of 540 stocks over 20-year period. Two basic stock groups of 25 and 50 individual stocks, averaged, are plotted against market (figured at zero per cent). Resultant chart shows all-important slope of curve which – far more than gross increases – tells the story of the stocks' vitality. No list of statistics, no matter how exhaustive, could give the relative interactions shown here. This picture is possible only with a graph.

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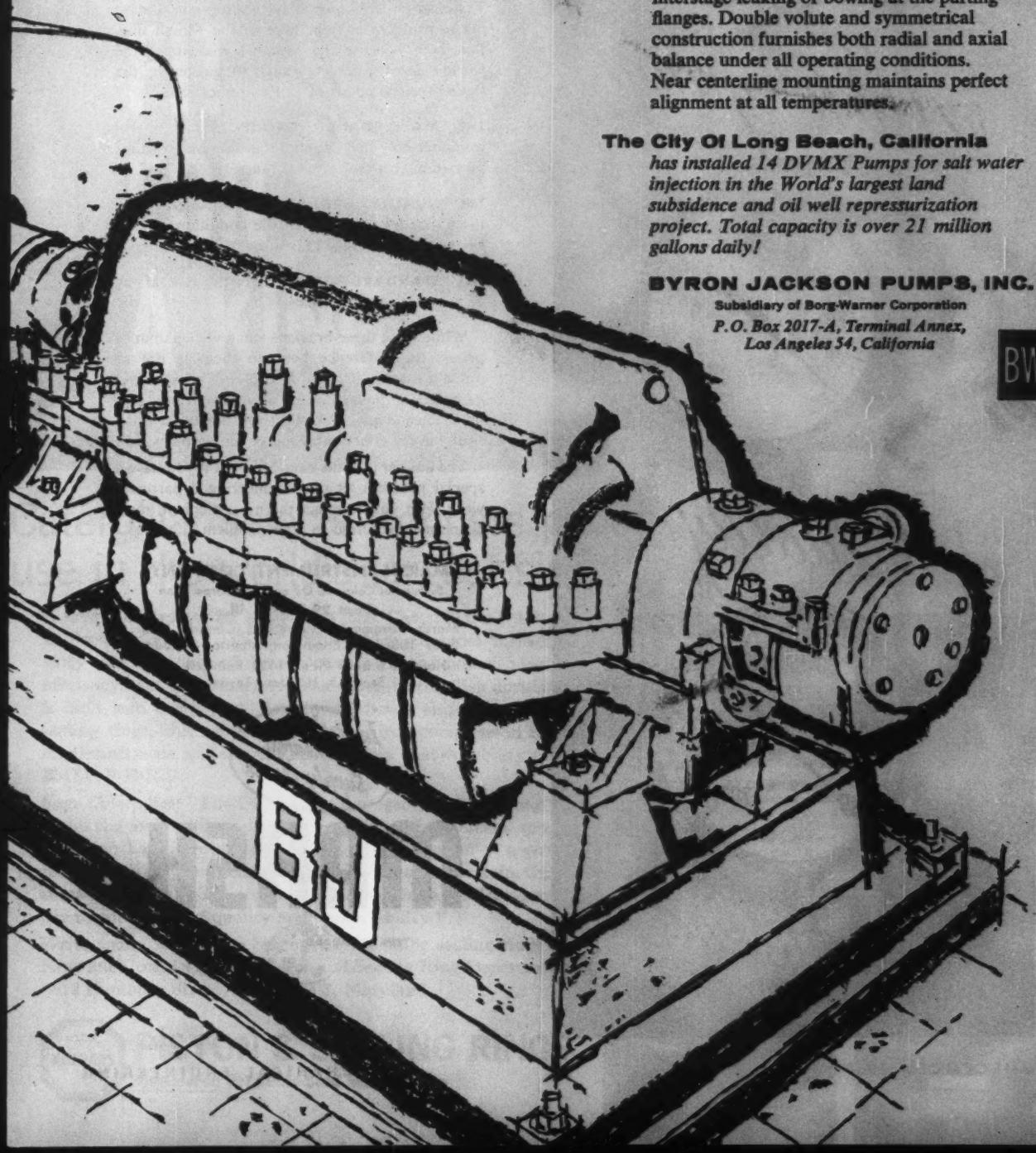

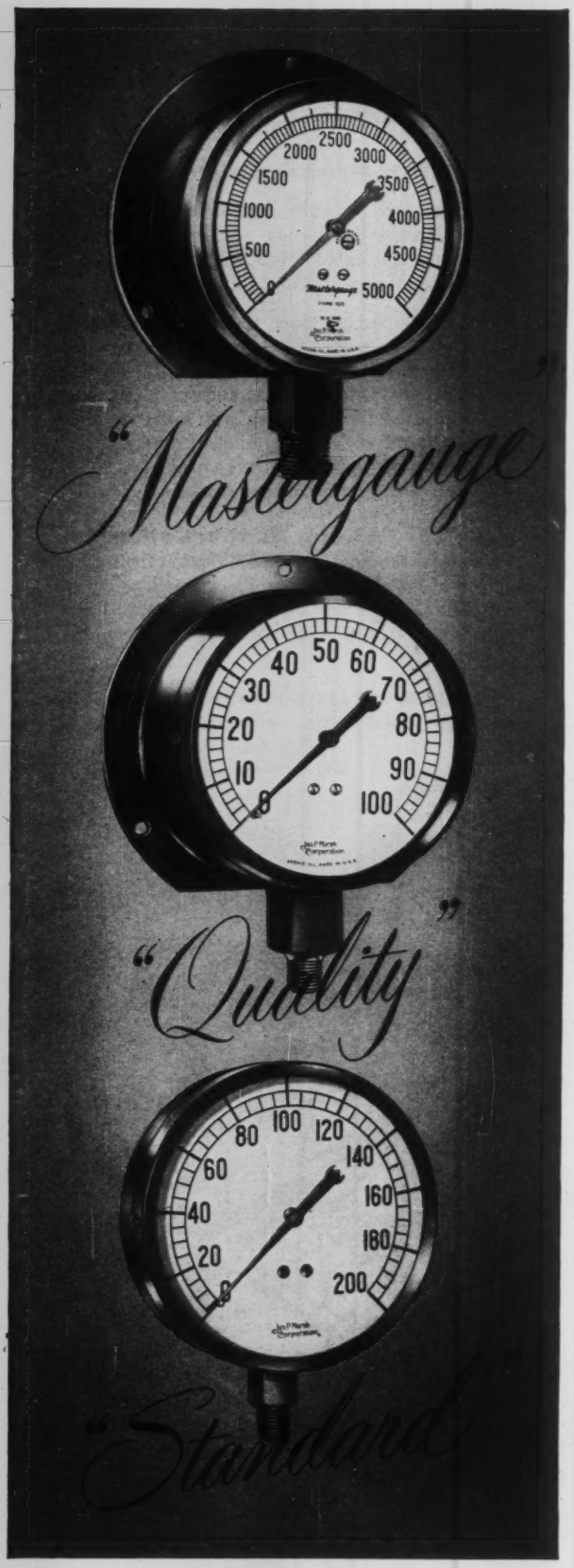

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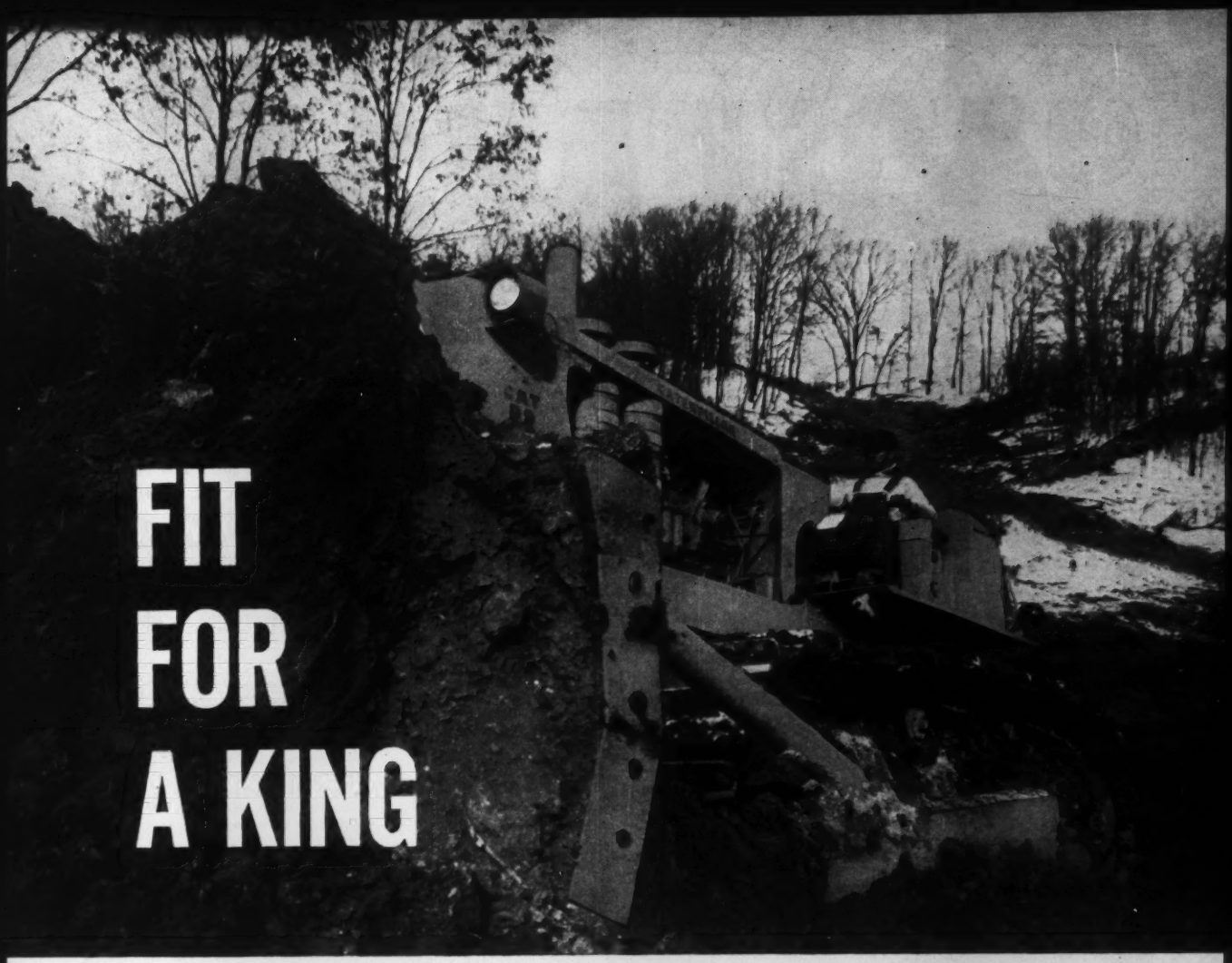
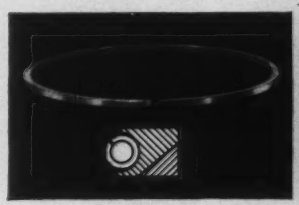


Caterpillar selects Koppers piston and sealing rings for use in the world's largest single engine crawler tractor.

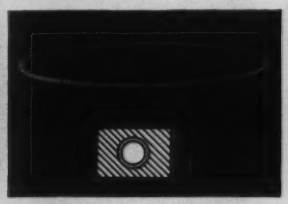
A brute of a tractor for brute force jobs, Caterpillar's D9 Series E Tractor applies a 335 HP engine which combines the versatility and economy of diesel power with the power boosting efficiency of a turbocharger. Traditional Caterpillar durability is built into every part. And in the power shift transmission sealing rings, chrome plated malleable iron compression rings, crankshaft seals, and steering control seals, that durability spells K-O-P-P-E-R-S.

Says Caterpillar: "The D9 Tractor is ruggedly built for long life under the most severe operating conditions. In addition, special attention has been given to insure the production of a power plant that is easy and economical to operate and maintain. On all these counts, the Koppers rings and seals we have selected meet our requirements of quality and dependability."

Write today for 8 page brochure on metallic sealing rings to: KOPPERS COMPANY, INC., Piston and Sealing Ring Department, 6812 Hamburg Street, Baltimore 3, Maryland.



CRANKSHAFT SEALS: Application of a conformable step seal ring (specially designed for Caterpillar) establishes a *permanent* crankshaft seal, reliable for the life of the engine.



TRANSMISSION SEALING RINGS: Specially designed metallic sealing rings transmit fluid power to the rotor and actuate the clutches of Caterpillar's dramatic new power shift transmission.

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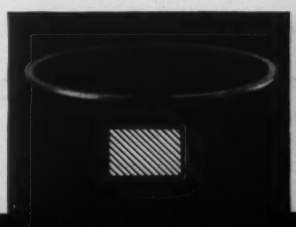
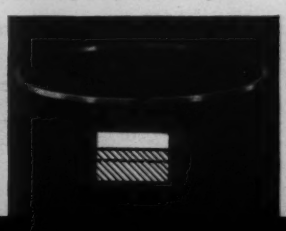
STEERING CONTROL SEALS: Caterpillar's new design steering control requires a rotating, high pressure seal. Piston ring type seals establish simplicity, reliability.





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Fans, rotors, turbines, gears, wheels, and shafts are but a few of the thousands of rotating devices that can be checked under dynamic operating conditions with the new Strobotac . This instrument's short-duration bright, white light "freezes" any cyclic motion, permitting the observation of fine details. Speed can be accurately measured . . . or, by slightly offsetting the Strobotac's flashing rate from the actual rotational rate, objects can be observed in apparent slow motion.

- ★ Useful up to 250,000 rpm. Direct reading range calibrated from 110 to 25,000 rpm; accurate to ±1%.
- ★ Short 0.8 μsec flash duration on high-speed range.
- ★ Light 70 times brighter than that of previous model. Long-throw beam reaches deep into dark crannies of machinery.
- ★ New mechanical features . . . pivoting lamp . . . a carrying case which provides protection and doubles as an adjustable stand for bench use.

Type 1531-A Strobotac® Electronic Tachometer and Motion Analyzer . . . $260.

(Photo courtesy of MIT Aeroelastic and Structures Research Laboratory, Department of Aeronautics and Astronautics.)

The Strobotac's long-throw beam makes it possible to observe in detail a model helicopter rotor operating in a wind tunnel. Blade lag and flapping are clearly observed in slow-motion. This technique shows what is happening to the rotor under various flight conditions and at the same time serves as a visual check on vibration data provided by strain gages mounted on the rotor head.

At General Electric's Small Aircraft Engine Department, the Strobotac helps engineers examine vibratory modes in aircraft gas-turbine blades. In this work, the new Strobotac's short-duration white light greatly improves visual resolution. Mode shapes are clearly defined at various excitation frequencies produced by an electro-magnetic driver.

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MECHANICAL ENGINEERING

VOLUME 82 • NUMBER 12 • DECEMBER, 1960

It's Everybody's Atom

Since that mysterious explosion took place over a desert in New Mexico some 15 years ago, atomic energy has come a long way in its quest for peacetime applications. And American industry is playing a tremendous role in harnessing the atom for the benefit of mankind.

On October 12, for example, Commonwealth Edison's 180,000-kw Dresden Nuclear Power Station was dedicated. Dresden is the first full-scale, privately financed, all-nuclear power plant in the world. This new station was termed "a milestone not only in nuclear progress but in the utility industry throughout the world." For details on the dedication see **Briefing the Record**, page 64.

Looking into the immediate future, The Martin Company announced recently that, by November, 1961, the first atomic power plant to be used in the Antarctic will be ready for shipment to McMurdo Sound by Navy Transport. It is shown in **Photo Briefs**, page 78. This is the principal base of operations for all U. S. scientific efforts in Antarctica. Designated PM-3A by the Atomic Energy Commission, the portable, medium-power range, pressurized-water reactor will have a net output of 1500 kw plus 650,000 Btu per hr of steam (part of which will be used to melt snow). Units of the plant are prefabricated at Martin's, Baltimore, Md., plant in 18 basic modules. Each module measures 8 ft 8 in. × 8 ft 8 in. × 30 ft, weighs less than 30,000 lb, and can be transported by C-130A aircraft if necessary. This, too, is a bold step, particularly on the economic side: The cost of transporting diesel fuel to a remote area like the Antarctic would be much greater than the nuclear fuel required to produce the same amount of electricity.

Then there are other future sources of nuclear power: Harnessing the steam produced by underground explosions of hydrogen bombs, creating underground reservoirs, moving earth to make artificial harbors, distillation of oil shales in place underground, and the like. Many of these ideas, as pointed out in **The ASME News**, MECHANICAL ENGINEERING, November, 1960, page 128, have been discussed by ASME's Technical Development Committee—but there are problems. Biggest problem? Molding favorable public and political opinion toward "Operation Plowshare," the name under which these various plans fall. Also, there is a need to offset international barriers that plague the continuation of these studies.

Of course, an excellent way in which to mold public opinion is through educational exhibits. One such exhibit, "Atomic Energy in Action," was opened to the public recently by Union Carbide Corporation. The colorful scientific display is set up just off the main lobby on the second floor of Union Carbide's new headquarters building in New York City. Designed to give the public a better understanding of the field of atomic energy, visitors will see the world's largest operating model of a nuclear research reactor and what is estimated to be the largest model of a uranium atom. The display, a skillful blending of graphics and animation, traces the history of the atom from 500 B. C. up to present-day peaceful uses of atomic energy. See **The Roundup**, page 109.

Hence, once the aura of mystery that surrounds the atom is dispelled from the public's mind, even greater and more dramatic peaceful developments should emerge for the benefit of all mankind.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

How do you compare the capabilities of individual engineers when your information comes from supervisors of differing temperament and viewpoint. To normalize section bias, here is a...

...new SYSTEM of merit

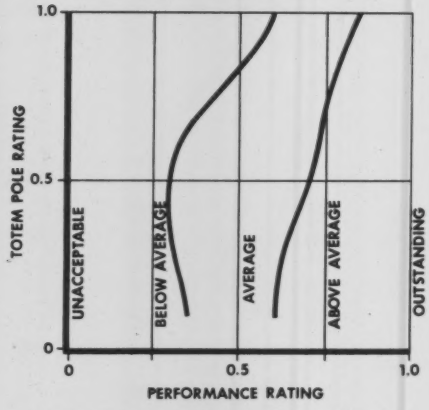

Fig. 1 The composite personnel evaluation is an envelope formed by two curves arbitrarily drawn to contain, say, 90 per cent of all individuals, with 5 per cent to the right representing upper-limit performance and 5 per cent to the left representing lower-limit performance. It is based upon individual points establishing each engineer's x, y-position based upon level of responsibility and performance rating.

By Kenneth D. Holland,

Mem. ASME,

Consulting Mechanical Engineer,

Pacific Palisades, Calif.

THE diverse talents and widely varying responsibilities of the members of a large engineering organization make the evaluation of professional merit complex. Yet management must make decisions concerning raises, promotions, and reorganization which require the evaluation of these individuals in relation to each other. In a large organization, this ever-recurring evaluation process is necessarily decentralized to section levels within the over-all engineering department. Subsequent to the completion of the section evaluations, management integrates them into a composite departmental presentation to be used as the basis for decision.

The validity of the final composite presentation, whatever its format, is maintained only by thoughtful treatment of a number of factors: (*a*) Identical standards must be applied to all individuals; (*b*) the procedure for integrating section evaluations into the composite departmental presentation must be formulated in explicit terms; (*c*) the effect of varying standards of evaluation between supervisors must be detected and eliminated; (*d*) finally, and most important, the results must be presented in a way that certain knowledge is obtained on each individual's relative standing and the reasons for it.

Format and Interpretation of Graphical Presentation

To indicate directly the relative standing of all individuals within the engineering department, a meaningful, graphical presentation of professional merit requires dual, independent ratings. The first rating determines the individual's relative level of responsibility and is shown on the *y*-axis as the "Totem Pole Rating." The second rating indicates the quality of application of the individual's capabilities to this responsibility and is shown on the *x*-axis as the "Performance Rating." When the dual ratings of all individuals are plotted and curves are drawn through the distribution so that an arbitrary fraction of the total population is contained within the envelope formed by these curves, the result will probably

Contributed by the Management Division and presented at the Summer Annual Meeting, Dallas, Texas, June 5–9, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 60—SA-31, originally entitled "A New Approach to Engineering Personnel Evaluation in a Large Organization."

RATINGS

appear as shown in Fig. 1. For clarity, individual points are not shown. This envelope might contain, say, 90 per cent of all individuals, with 5 per cent to the right representing upper-limit performance and 5 per cent to the left representing lower-limit performance.

The shape and extent of the envelope reveal some interesting characteristics of the organization. The envelope, in bending to the right as it rises, shows that, as higher levels of responsibility are encountered, a correspondingly higher quality of performance is required. A preponderance of points in the lower right quadrant indicates that these promising, less experienced engineers should be trained and assigned to more responsible positions as soon as possible. Conversely, individuals in the upper left quadrant are not maintaining the necessary competence to fulfill their assigned responsibilities.

Totem-Pole Rating

As previously defined, the Totem-Pole Rating indicates the relative importance of assigned responsibilities. Each section supervisor independently establishes a totem-pole framework for his own section by separating all section assignments into a small number of discrete levels of responsibility. A numerical range is defined for each level within a total 0.100 to 1.000 range[1] and each engineer is placed at the proper level. If practical, smaller differences in job importance may be expressed within each range. In completing this part of the evaluation, the supervisor is concerned only with the relative importance of assigned jobs in his own section and not in any way with the effectiveness of holding an assignment.

Performance Rating

The major problem in designing a system for performance ratings is the delineation of merit factors. To minimize effects of diverse interpretations, direct rating of abstract personal qualities (originality, resourcefulness, efficiency, initiative) must be avoided. Instead, the application of these qualities to the assigned responsibilities is measured in the form of scores for specific questions. Approximately forty questions are developed

[1] For morale, the 0.00 to 0.10 range is not used.

Your Supervisor Will Ask Himself:

TECHNICAL COMPETENCE

1 Are his ideas imaginative and original (as opposed to modifying existing ideas)?

2 Does he recognize and utilize existing ideas in solving his problems?

3 Is his work accomplished and documented in a neat, thorough, and systematic manner?

4 Are his ideas theoretically sound?

5 Can he proceed in his work without continual technical guidance?

6 Is his work consistently reliable in accuracy?

7 Does he properly plan the approach to his work so that the schedule will be met?

8 Does he constantly increase his level of technical knowledge, both specialized and general?

HUMAN RELATIONS

1 Does his attitude inspire co-operation?

2 Does his manner of presentation inspire respect for his work and conclusions?

3 Does he consistently give credit to work supporting his own?

4 Is he adaptable to changes in plans, including those with which he does not agree?

5 Does he work efficiently in close co-operation with others?

ADMINISTRATION AND SUPERVISION

1 Is he competent in estimating the scope and magnitude of his assignments in advance?

2 Does he keep his superiors well informed of the progress of his work on his own initiative?

3 How well does he simultaneously manage several problems and maintain the proper perspective for each?

4 Does he adequately supervise the execution of all assignments made to subordinates?

5 Does he properly delegate responsibility and authority for all assignments made to subordinates?

6 How well does he understand and utilize the organization system and facilities in his work?

...new SYSTEM of merit RATINGS . . .

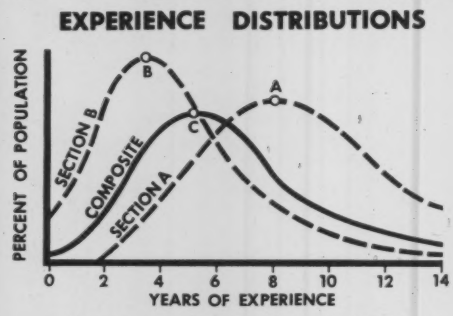

Fig. 2 A composite experience distribution **C** is based on two smoothed section distributions for the preliminary-design section **A** and the testing section **B**

to meet the needs of the organization and are separated into three categories: Technical competence, human relations, and administration/supervision. The questions are identical for all individuals in the organization and are equally weighted within a single category.

In addition to specifying merit factors in the form of questions, a scoring system must be established. The best terminology, with the least probability for diverse interpretations, are the words outstanding, above average, average, below average, and unacceptable. Each of these terms is assigned a numerical value on a linear scale from zero to 1, with 0.500 being average. The Performance Rating for each individual is the summation of the category scores, each multiplied by the weight value assigned to that category.

Weighting and Integration of Section Evaluations

To obtain the composite departmental evaluation, all the section evaluations must be integrated in such a way that the final presentation is not invalidated. The integration process consists of the application of three independent weighting functions to each section evaluation. These are the totem-pole weighting function, the performance weighting function, and the normalization of section bias.

The totem-pole weighting function is required to redistribute the levels of responsibility of one section relative to those of all the other sections. For instance, the totem pole of a preliminary-design section with a high percentage of experienced engineers with correspondingly higher levels of responsibility cannot be directly integrated with that of a testing section with a majority of junior engineers. The solution to their integration is to weight the totem pole of each section based on its experience distribution relative to the overall department distribution. Fig. 2 shows two smoothed section distributions compared to the departmental composite. Section A would be the preliminary design section, whereas Section B is the testing section. Based on these curves, the department management specifies the weighting functions shown in Fig. 3. The top levels of responsibility in both sections are assumed equal.

The performance weighting function corrects for the variance between sections in the emphasis placed on the three categories of personal capabilities. For instance, in a project-management section, human relations and administration/supervision talents are quite important

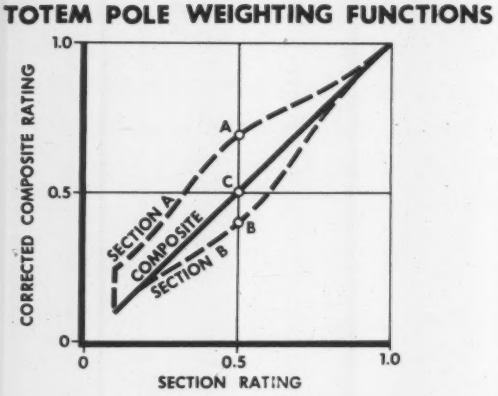

Fig. 3 The department management specifies weighting functions based on Fig. 2. Here, the top levels of responsibility in both sections are assumed equal.

whereas technical-competence requirements are not so stringent. The inverse is true for a research section. Weighting the three categories accordingly permits equitable emphasis on a comparative basis.

Finally, detection and normalization of section bias are necessary before the corrected co-ordinate values for each individual can be determined. Subsequent to the application of the totem pole and performance weighting functions to the section evaluations, all individuals are plotted and Fig. 1 is obtained. This curve is assumed to possess the true distribution in both dimensions. The corrected co-ordinates for each individual are obtained by mathematically comparing each section plot, prior to application of the totem-pole weighting function, to the composite department plot and correcting all co-ordinates so that the two plots are mathematically similar. Once obtained, each engineer receives his own co-ordinates and a copy of the Performance Rating questionnaire which is discussed with him in detail.

Implementation of the Method

The complexity of such a method of personnel evaluation is a function of the size of the organization. For a large organization, a computer must be utilized. This complexity, however, is faced only once in the formulation of the mathematical model and is not repeated with each evaluation period. For smaller organizations, the procedure can be greatly simplified.

A number of readers will raise the ancient objection to an attempt to reduce human capabilities to magic equations and numbers. The defense for such a system is that these methods already exist, consciously or subconsciously, in the minds of all those responsible for evaluating others. To obtain a valid evaluation of many engineers and maintain fairness to each individual, all these unexpressed intangibles must be formulated explicitly so that diverse interpretations of values can be exposed, debated, and reconciled into a single equitable system applied to all.

Implementation (and publication) of such a procedure permits a clear understanding of the method by which each engineer is evaluated. Section biases cannot artificially affect an individual's progress, and, most important, each engineer has certain knowledge of his relative standing in the organization and the reasons.

Progress Report: SOLAR ENERGY IN 1960

Engineers harnessing solar energy as a power source can point to their success in powering satellite communication. Research for the space program may hasten the day of commercial solar energy.

By J. I. Yellott,[1] Mem. ASME

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THE successful use of silicon solar batteries on a large scale as power sources for satellite communication systems is 1960's most important contribution to solar-energy utilization. Still far too expensive for any but the most exceptional earthbound applications, the silicon cells which were invented in 1954 and first put into orbit by Vanguard I on March 17, 1958, are standard equipment on the increasingly large and complex vehicles which have been orbited by the United States during 1960. The heavier but less versatile Russian vehicles appear to place more reliance on chemical batteries which are initially powerful but are relatively short-lived.

Primary emphasis continues to be placed on research which will lead to bigger and better satellite power generators. Progress is being made in developing light-weight reflectors, radiation-absorbing surfaces with selective wave-length characteristics, and so on, and these components will ultimately be useful in earth-bound as well as space applications.

[1] Chairman, Solar Energy Application Committee, ASME.

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The use of radiation-absorbing roofing materials as solar energy sources for the heat pump is receiving increasing attention in areas where electricity is available at moderate cost and particularly where summer cooling is essential. Where fossil fuels are abundant and cheap, the first cost of solar-energy utilization systems is still too great to enable them to compete with conventional fuel-burning equipment.

Distillation of drinking water from the sea is one application which holds promise of becoming competitive with oil-burning systems in those regions where sunshine is abundant and petroleum is expensive.

Space Vehicles

In outer space, where clouds and nocturnal darkness do not exist, and where refuelling is impossible with today's technology, the sun's unfailing radiation becomes attractive as a power source. For the first time in the long history of solar-energy research, relatively large amounts of government funds are being assigned to projects which will lead to the building of small but reliable solar-power devices.

The silicon solar cell, which came out of the Bell Telephone Laboratories in 1954 as a by-product of their transistor research, was the twentieth century's first really important break-through in solar-energy technology. Generation of minute but significant quantities of electricity directly from sunshine by photovoltaic cells was well known prior to World War II, but the conversion efficiency of these devices was so small—less than 0.5 per cent—that they were little used except for

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SOLAR ENERGY IN 1960

control and light-measuring purposes. The first Bell silicon cells showed efficiencies of 5 to 7 per cent, and steady development has brought about a twofold improvement in their performance. Licenses under the Bell patents have been granted to a number of manufacturers, and solar batteries are now being produced in large quantities both in the United States and Japan.

The characteristics of the silicon solar cell are now well known. It responds primarily to the visible and near infrared portions of the solar spectrum, and each cell can generate approximately 0.6 volt in bright sunshine. Power output varies directly with intensity of the incident radiation but, because of the limited size of the cells which can be cut from a single silicon crystal, the maximum output per cell is only about 20 milliwatts. Output drops off as cell temperature increases, and so the 1960-model silicon cell is usually protected by filters which will reflect away the unusable ultraviolet and infrared.

The first U. S. satellite to go into a "permanent" orbit, Vanguard I, carried four small batteries of silicon cells when it was sent aloft on March 17, 1958. Thanks to these solar cells, it is still transmitting the results of its measurements back to the earth. Encouraged by this success, the designers of most of the succeeding satellites incorporated more solar cells into their vehicles. Pioneer V, now in perpetual orbit around the sun, carries 5000 silicon cells on four double-sided paddles which were unfolded after this satellite was separated from the vehicle which carried it aloft.

Power for the Cameras

Most remarkable of the American satellites was Tiros I, which used a battery of 9100 silicon cells to convert sunlight into electricity for its television camera and transmitter. This miniature moon sent back thousands of tape-recorded pictures of the earth and its cloud cover. Their detail was so good that the Weather Bureau has requested a supplementary appropriation to enable these photographs to be analyzed and compared with the meteorological conditions which prevailed when they were being taken.

The largest solar-electric generator which is now on order for a space application will use 50,000 cells mounted on 12 panels to produce 1140 watts. These cells, produced by Hoffman Electronics Corporation, will have a guaranteed efficiency of 12 per cent.

Another approach is being made to the problem of high-output solar batteries through the use of reflectors to increase the amount of solar radiation which can reach a battery of solar cells. With this method, the temperature of the cells also rises but it is believed that this heating can be controlled by selectively surfaced filters which will also protect the cells from the intense proton radiation of the Van Allen belt.

At the present time, silicon cells can only be made from single crystals and they are therefore limited in size and very costly. Intensive research is going forward in many laboratories to find ways of increasing the size and reducing the cost of solar batteries. The break-through which will accomplish this remains to be made.

Vapor Cycles

When outputs above a few kilowatts are needed, vapor cycles appear to offer advantages in size and weight as compared with photoelectric devices which are inherently limited to efficiencies below 20 per cent. Several projects are now under way to produce power plants in the 3 to 5-kw range which will use folding parabolic reflectors to concentrate the sun's rays upon compact vapor generators.

The "Sunflower" solar power unit will employ a 32-ft-diam collapsible concentrator to produce mercury vapor for a 3-kw turbogenerator. A supply of lithium hydride will be used to store enough solar heat to operate the plant for 1.5 hr. The cost of this undertaking, $4,900,000, is greater than the total of all previous nongovernmental expenditures on solar-energy research.

It is reported that more exotic vapors are under consideration for applications where extremely low ambient temperatures are likely to be encountered. The condenser for a space-platform power station presents a design problem which is even more difficult to solve than the solar-heat collector. The maximum amount of solar energy which can be collected on a square foot of surface (at Earth's distance from the sun) is 441 Btu per hr. Making the optimistic assumption that a thermal efficiency of 25 per cent can be attained, 330 of those Btu must be rejected per hr. If the condenser is to be no larger than the collector, it must run at a surface temperature of approximately 200 F in order to radiate heat into outer space at this rate.

Since space platforms are expected to operate where weight and wind are equally absent, it is possible to contemplate extremely large parabolic concentrators made of metallized Mylar, but condensers of similar dimensions present far more formidable difficulties. Despite these problems, design contracts are now being fulfilled for several solar plants which will first be tested on the earth's surface and then restudied for possible space applications. Energy storage continues to be a major stumbling block for the designer of a solar plant which must operate during even brief periods of darkness.

Direct Conversion

Thermionic and thermoelectric converters can both be activated by solar heat if they are placed at the focal areas of radiation concentrators. Both of these devices offer possibilities of higher conversion efficiencies than can be attained by photovoltaic devices because they can use all of the solar spectrum rather than only the portion which can activate a silicon cell. Thermionic converters can use temperatures as high as 2000 F to heat their electron emitters, and this qualifies them for use with parabolic sunlight concentrators.

Thermoelectric devices are at present restricted to lower temperatures because the alloys which have shown the best conversion efficiency have relatively low melting points. Encouraging results have been obtained with low-energy nuclear heat sources, placed at the center of the thermocouple arrays. The principal virtue of such

systems is their ability to produce power at a constant rate for long periods of time, without attention. The principal drawback to both systems is their small output and high cost. Like the solar battery, their best application is in space platforms rather than on Earth.

Food and Oxygen

One vitally important process for which solar energy is essential is the growth of chlorophyll-producing plants on a large scale. The food which we eat and the oxygen which we breathe are produced by the natural photochemical processes of plant growth. Before man's entry into space was seriously contemplated, scientists concentrated their attention on the problem of producing the maximum amount of nutritive substance, and particularly protein, from a given agricultural area. Photosynthesis received far more attention in the prespace era than any other aspect of solar-energy research, and it was found both in the United States and in Japan that certain algae could be grown at extremely rapid rates if they received enough carbon dioxide and light. The production of edible protein from an acre of hydroponic algae-farm can be many times greater than from any other source, but, thus far, the cost of the processed food has also been considerably higher than that of natural foods.

Now, algae cultivation is again receiving attention as a means of making possible extended interplanetary journeys. In their growth process, algae convert carbon dioxide, water, and sunlight into plant substance, oxygen, and heat. Serious studies are now going forward to devise systems whereby astronauts of the future, in their self-contained miniature worlds, can obtain both their food and their oxygen from constantly renewed hydroponic gardens.

Solar-Energy-System Components

Intensive research is under way both in universities and industrial laboratories to develop the components which will be needed in tomorrow's solar power devices. Particular attention is being given to developing collector surfaces which have high absorptivity for solar radiation but low emissivity for long wave lengths. Conversely, surfaces are also being sought which can reflect most of the sun's radiation but which are good emitters of low-temperature radiation.

Just as the atomic-energy program has opened up the world of nuclear physics, the renewed interest in solar energy has reopened the door to classical physics. The science of optics, neglected since the dawn of the atomic era, is again being studied to develop the theory of heat radiation and absorption and thus to find a rational basis for improving the performance of solar-energy concentrators, absorbers, and rejectors.

Radiation characteristics of a wide variety of materials, from parachute fabrics to exotic alloys, are being studied over the temperature range from 400 to 4000 R. Selective surfaces have been developed which are far better than the dull black paint which was universally used in prewar solar heat collectors, but it remains to be seen whether these materials will retain their desirable properties for long periods of high-temperature operation.

From the mechanical point of view, we are passing from the stage of artists' concepts of fanciful solar power plants to the design and building of actual hardware. The space and weight requirements of these missile-borne, ultracompact energy converters are so completely at variance with conventional steam stations that the design work is largely being done by engineers in the aircraft industry. For missiles in which an extra pound of weight means the loss of a mile in range, economy in the use of structural materials is just as important as the selection of the proper thermodynamic cycle.

An interesting analogy exists between the turbine industry and the field of solar-energy applications. Prior to the introduction of the jet engine, turbine know-how was the exclusive possession of a handful of designers in less than a dozen companies in the United States. Today, turbine and compressor specialists are in plentiful supply. Before Russia's Sputnik I turned the world's thoughts toward the conquest of space, solar-energy applications were the province of a few university scientists. Today, every airframe manufacturer has a corps of solar specialists, augmented by engineers who must design practical apparatus and make it work.

Down to Earth

The use of solar energy to generate power on the earth's surface, while attractive in principle, faces almost insuperable economic obstacles at the present time. The predictable dawn-to-dusk and seasonal variations of solar radiation, and the unpredictable interruptions by clouds, leave only a few applications where conventional fuel-burning equipment cannot do a more economical job. Where power is required for pumping irrigation water or running generators, small mass-produced gasoline engines are available at such low prices that solar devices offer no competition. Only in the still-to-be-developed tropical areas, where sunlight is plentiful but fuel is expensive and electricity nonexistent, would solar-powered pumps and generators find wide use if they were available.

Earth-bound solar apparatus must face the fact that the intensity of the radiation which reaches the earth varies from zero at dawn through a maximum of 350 Btu per hr per sq ft at noon, to zero again at dusk. In most parts of the world, the maximum may be reduced to 50 Btu per hr by heavy cloud cover, and even this meager amount cannot be concentrated because it is diffuse rather than direct. Ten sq ft of collecting surface can intercept enough noon-hour sunshine to give the equivalent of a kilowatt-hour, but the conversion efficiency of low-temperature power plants is so small that, in practice, the actual requirement has always been closer to 100 sq ft.

When heat at moderate temperature is the objective, rather than power, solar installations can make a much better showing, since they do not suffer from the 10-to-1 efficiency limitation. Distillation of sea water, swimming-pool heating, space heating and cooling, and cooking are among the applications in which progress can be reported.

Sea-Water Distillation

The first large-scale application of solar energy was undoubtedly the evaporation of sea water to produce salt. The converse of this process, partial evaporation and condensation to produce potable water, was put into operation in South America nearly 90 years ago. Solar stills make use of shallow blackened boxes or inclined surfaces of black fabric, covered with a transparent material such as glass or certain plastic films which have the property of transmitting the sun's rays but are opaque to long-wave-length radiation. When salt water fills the shallow box or flows along the blackened fabric, it can be

partially evaporated, and the vapor will condense on the relatively cool lower side of the glazing material. The condensate can be drained off into storage tanks and the brine returned to the sea.

During the past year, the performance of solar stills has been the subject of detailed study both in Florida and in California. Analysis of still performance has shown where the principal losses in efficiency take place and pointed the way toward improved designs. The heat loss from the glazing which covers a solar still takes place both by radiation and convection, and little can be done about the latter factor without excessive still cost.

Treatment of the surface to minimize radiation from the water to the glazing and from the glazing to the sky is possible with newly developed techniques which can be applied to both glass and plastics. With these techniques, which are still in the laboratory stage, the output of water per sq ft of still area can be almost doubled as compared with conventional designs. For certain arid regions of the world, solar stills of even the simplest design are useful as sources of drinking water and, for small requirements, they are competitive with other methods. No way has yet been proposed by which sea water can be desalted at low enough cost to allow the fresh water thus produced to be used for irrigation.

The Solar Furnace

When solar radiation is concentrated by the use of polished parabolic reflectors, its intensity can be raised to the point where temperatures approaching that of the sun's surface can be realized. Small solar furnaces, made from converted wartime searchlights, are now in wide use as sources of high-intensity radiant energy. No new large furnaces have been constructed during the past year, but significant work has been reported in the use of solar furnaces and filters to produce high intensity ultraviolet radiation.

It now appears unlikely that the giant solar furnace proposed for Cloudcroft, N. Mex., will be built in the form which was originally proposed. This furnace was to have used a 100-ft-diam concentrator, but its cost was considered to be excessively high in view of the fact that other sources of high-temperature environments, such as plasma jets, are now available. It is reported that the Air Force is seeking funds for a solar-energy laboratory at Holloman A.F. Base, where sunshine is available throughout the entire year.

Heating and Cooling

Heating of homes and small office buildings continues to be one of the most promising applications of solar energy. The roof area of such structures is usually adequate to collect most of the energy needed to keep them comfortably warm during moderate winters. Heat storage by means of buried tanks of sun-warmed water has proved to be feasible, if somewhat clumsy and costly.

Experience in the use of the heat pump as the source of auxiliary winter heat and summer cooling has been gained by the consistent operation of homes in Lexington, Mass., and Tokyo, Japan, as well as in the Bridgers and Paxton office building in Albuquerque,[2] and the University of Arizona Solar Laboratory in Tucson. The Tokyo and Tucson applications are interesting in that they use radiation from their roofs to the night sky as a means of rejecting the heat which their air-conditioning systems remove during the day.

Where cheap natural gas is available, conventional furnaces will continue to be the most economical means of heating, even in the sunny southwest. The heat pump, with solar-heat collection and storage, becomes much more attractive when electricity is the only convenient energy source. The dual use of copper or aluminum "Tube-in-Strip" as lifetime roofing and as radiation collection surface brings the incremental cost of solar heating down to where it will be used more and more widely in conjunction with relatively small heat pumps.

Energy storage by water tanks, cylinders of rocks, or by chemical means, allows a smaller heat pump to be used with a given heating or cooling load, since the peaks can be taken by the stored heat or cold.

The use of flat-plate solar collectors as heat sources for absorption refrigeration is being studied at the University of Florida. Since most of the regions which require extensive air conditioning are also blessed with abundant sunshine, the development of year-round solar-powered comfortizing equipment is being watched with much interest. Summer cooling is one of the few applications where the peak load occurs when the energy input is also at its maximum.

Heating of swimming pools is an application of solar energy which is meeting with some success in the sunny southwest. The solar water heaters which are in such wide use in Florida, and which were used throughout the southwest before the advent of natural gas, are the prototypes for many pool-heating installations. The principal drawback of the conventional hot-box solar water heater is its cost, which usually approaches $3 per sq ft. A number of development projects are now under way to reduce this cost through the use of plastic films instead of cover glasses, and by using extruded or molded-plastic heat absorbers.

Conclusions

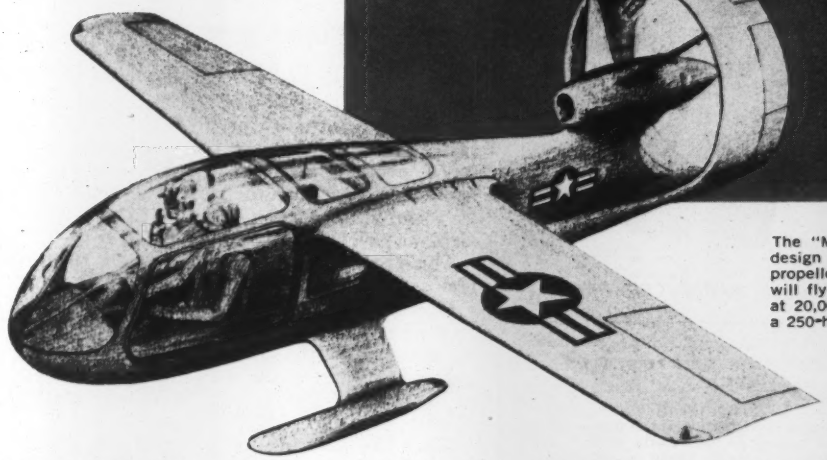
Much of the development work in solar energy lies within the province of the chemist and the physicist rather than of the mechanical engineer. The amounts of power which can be generated by feasible solar devices are so small, and the devices themselves are so costly, that the only really practical applications are in connection with space projects. A few installations of photoelectric converters for remote radio relay stations, harbor warning lights, and so on, have been made both in the United States and Japan, but they can be justified only where the cost of replacing ordinary chemical batteries is extremely high.

The improvements in the technology of solar-energy utilization, which will be made in conjunction with the space program both here and abroad, will hasten the day when the sun's radiation can be used economically on the surface of the earth.

[2] F. H. Bridgers, D. D. Paxton, and R. W. Haines, "Solar Heat for a Building," MECHANICAL ENGINEERING, June, 1957, pp. 536–538.

The Ducted Propeller

High thrust at low speeds with moderate engine power, makes the ducted propeller ideal for short take-offs.



The "Marvel," a proposed design for a ducted-propeller aircraft which will fly at 500 mph at 20,000 ft with only a 250-hp engine

By August Raspet, Professor, Aerophysics Department, Mississippi State University, State College, Miss.

THE ducted propeller had its origin in the Kort nozzle used in Germany for tugboat propulsion in which a highly convergent nozzle was placed over a conventional propeller on which even the rounded tips were retained. As a result of the large effective tip clearance, the static thrust developed by the Kort nozzle was only 10 to 15 per cent better than an equivalent-diameter open propeller. In addition to the large tip clearance, the use of a standard propeller, or screw having blade setting decreasing toward the tip, did not permit operation in a flow field such as to yield the highest thrust, since a good portion of the outer-blade radius was immersed in the highly accelerated flow due to the convergent nozzle. The propeller was in effect windmilling toward the tips.

When ducted propellers were first tried in various aircraft applications, some effort was made to retain small tip clearance, although the classically twisted propeller was still used.

Because the ducted propeller offered a considerable increase in static thrust, early attempts at applying this concept were in the field of vertical lifting machines, such as the flying platforms, and multiple-ducted vertical lifting machines. Quite a variation exists in the static thrust attained by various designers. A few reached the theoretical limit for the shrouded propeller. These utilized a thin shroud, having chord-to-diameter ratios of 0.25.

By far, the best results were obtained by Krüger,[1] whose ducted propeller was built around a streamline body of revolution. The duct and propeller were mounted at the trailing end of the body, thus providing for additional diffusion of the flow.

Although the applications of ducted propellers to VTOL[2] aircraft have been most numerous, the concept of the ducted propeller, however, offers a real contribution to the highly efficient STOL[3] aircraft. It is this aspect of ducted-propeller technology which will be discussed.

This paper is the result of studies conducted under Office of Naval Research Contract with Sponsorship of U. S. Army Transportation Command.

Contributed by the Aviation Division and presented at the Aviation Conference, Dallas, Texas, June 5–9, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 60—Av-11.

[1] W. Krüger, "On Windtunnel Tests and Computations Concerning the Problem of Shrouded Propellers," NACA TM 1202, 1949.

[2] VTOL = Vertical take-off and landing.

[3] STOL = Short take-off and landing.

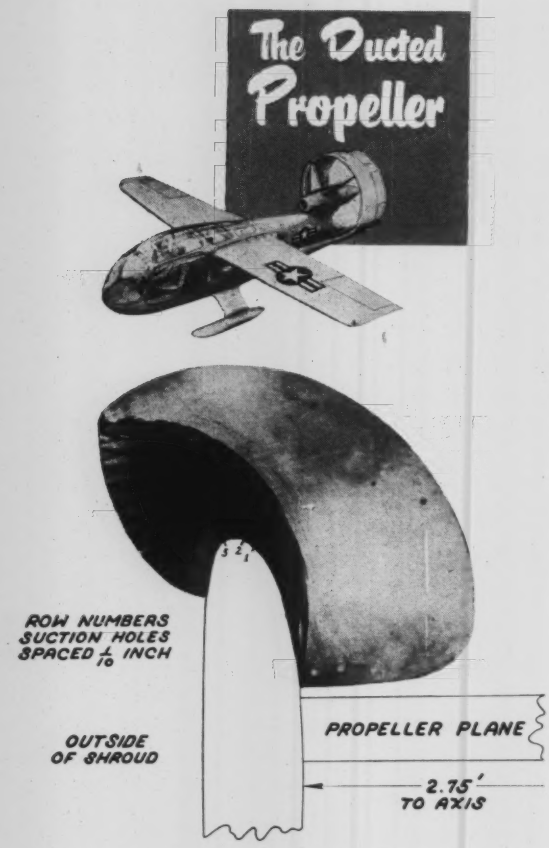


Fig. 1 Liquid-film photographic visualization of the flow around the leading edge of a duct having an NACA 4415 airfoil cross section, without boundary-layer control. Made by allowing a volatile liquid containing a dye to ooze out of a series of holes on a plate erected parallel to the duct section on the leading edge. The wide band of dye on the plate is on the outside of the duct. The area of separation is clearly evident where the dye is no longer deposited in the streamwise direction.

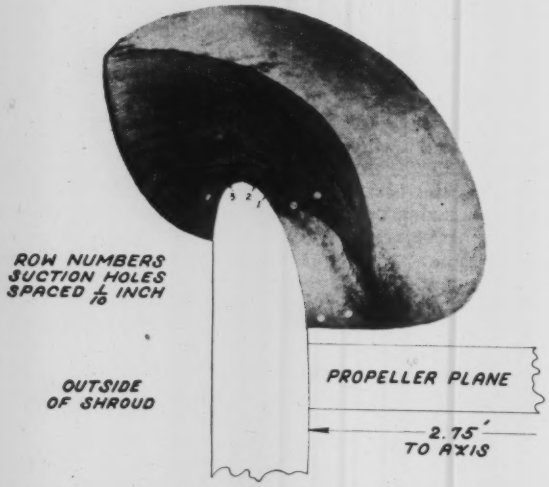


Fig. 2 Flow visualization of duct propeller inlet with suction boundary-layer control made by the liquid-film technique

Ducted Propeller for STOL Aircraft

The concept of the ducted propeller lends itself admirably to STOL airplanes. An STOL airplane by virtue of its high lift also possesses high induced drag, which must be overcome by means of a propulsion unit capable of developing high thrust at low speeds. Since the ducted propeller possesses this feature of developing high thrust at the low forward speeds at which STOL airplanes utilizing high-lift boundary-layer control fly, it permits matching the propulsor to the airplane without resorting to the usual approach of merely adding a larger engine.

However, when one considers the ducted propeller as a tractor, the idea is immediately thrown out, for the duct acts as a considerable destabilizing element in yaw. This consideration then automatically dictates that the ducted propeller be arranged in a pusher configuration. Arranged thusly, the duct can also be used as the stabilizing element, as suggested by Küchemann and Weber.[4]

Concept of High Thrust Combined With High Lift

Assuming that one designed a ducted propeller to develop a thrust equal to the weight of the aircraft, the question then comes up of whether it would not be more feasible to use this thrust to lift the airplane. One can easily resolve this aspect by computing the take-off speed attainable with distributed-suction boundary-layer control. With the already attained low stall speed of 35 mph, the take-off run with thrust equal to the airplane's weight comes to a mere 41 ft.

The climb-out with such a high thrust would be almost vertical.

However, one does not need to attain as high a thrust-to-weight ratio as unity. Excellent performance can be obtained with values between 0.6 and 0.8. Such values can be attained with engines of nominal powers of the order of 250 hp for a two-seater airplane grossing 2200 lb.

Since the duct acts as a stabilizing surface both for pitch and for yaw, it is also feasible to include control surfaces in the duct's after-section, thus providing yaw and pitch control.

Design Considerations for Ducted Propellers

A ducted propeller must be designed with two features in mind: (1) It must provide high thrust at low speeds; (2) it must not possess a high drag in cruising flight.

What these considerations imply is that the thickness of the duct cross section must be kept as small as possible without loss of static thrust.

The usual solution to this problem has been to use a bell-mouth entry for the duct and then complain about the high drag of this configuration, or else to try to make a variable-geometry inlet as was suggested by Krüger.[1]

However, recent studies of viscous flows on curved walls[5] have led to an understanding of the nature of the flow separation on the inlet to ducted propellers.

The usual criteria for laminar separation of viscous flows in adverse pressure gradients completely neglect the effects of centrifugal forces, tending to throw the flow away from the wall. In fact, all of the laminar-separation criteria are based on flat-plate flows.

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[4] Küchemann and Weber, "Aerodynamics of Propulsion," McGraw-Hill Book Co., Inc., New York, N. Y., 1953, p. 136.

[5] Mathur Maneshwar Chandra, "A New Simplified Form of Navier-Stokes Equations for Curvilinear Flows," Mississippi State University, Aerophysics Department, Research Report No. 24, May 30, 1959.

When the centrifugal forces are given consideration, as they must be for violently curved flows, these simple criteria are not valid.

A sailplane having an NACA 4416 airfoil whose turbulent separation was delayed by distributed suction provides an example of strongly curved flow. The airfoil was capable of developing a maximum lift coefficient of 2.4. Because of this high lift coefficient, the stagnation point lay fairly far back on the bottom surface and the velocity around the nose of the airfoil was actually 3.4 times flight velocity, which is large, but considerably smaller than that expected at maximum lift coefficient for this airfoil.

Separation of the flow takes place at exactly the point where the centrifugal forces exceed the static pressure gradient toward the wall. In other words, the criterion for separation for extremely curved flow fields does not depend on the viscosity of the air nor the boundary-layer thickness, but only upon the balance of centrifugal and pressure-gradient forces.

With this concept in mind, one can see that the basis for designing the so-called "high-speed" duct by simply rotating a classical airfoil is bound to lead to difficulties due to flow separation around the leading edge of the duct. The obvious reason for the classical airfoil's failure, when used for this purpose, lies in the fact that the classical airfoil is designed for angles of attack of no more than 30 deg, yet the duct entry must handle a change in flow direction of 180 deg.

To portray how abrupt the centrifugal separation on an inlet to a ducted propeller can become, Fig. 1 shows a liquid-film photo[6] of the flow around the leading edge of a duct having an NACA 4415 airfoil cross section. The liquid-film method consists of allowing a volatile liquid containing a dye to ooze out of a series of holes on a plate erected parallel to the duct section on the leading edge. The wide band of dye on the plate is on the outside of the duct. The area of separation is clearly evident where the dye is no longer deposited in the streamwise direction.

It is apparent from this illustration that the centrifugal separation is very abrupt taking off at an angle of almost 45 deg. It is also quite evident that the separated area will result in the propeller tip being stalled since the effective angle of attack of the blade tip is quite large when the flow velocity is low. The stalled propeller tip than results in a tip vortex which implies large induced drag, thereby resulting in poor propulsive efficiency at low speeds. Furthermore, the separation of the flow on the inlet results in a reduction of the suction-pressure peak on the inlet. A large loss of static thrust is then experienced by the propeller-duct combination.

If then an airfoil shape cannot be used for the duct cross section, what can be said about a better shape? Based on the concept of centrifugal separation, it can be said that the inlet should be so designed that the centrifugal term U^2/gR is[7] kept as low as possible around the nose. Obviously, what is desired is that the flow velocity will be low where the curvature is large. A surface which has such a behavior is that of a cambered elliptic inlet, with the camber concave outward.

When two cambered elliptic inlets of different eccentricity are compared, an elliptic inlet of eccentricity 4:1 allows unbalanced accelerations of 10,000 g to be developed in the flow, whereas for an inlet of eccentricity 3:1, this acceleration is down to 3200 g.

Pressure distributions taken along the wall for these two cases show clearly the pressure peak for the 4:1 ellipse to be much greater than that for the 3:1 elliptic entry.

It has been possible to design an inlet absolutely free of separation using the concept of transforming the Borda mouthpiece for use in axisymmetric flow. This was done by T. Maekawa.[8]

In addition to geometric means for controlling the flow around the leading edge of a duct, there is the possibility of using distributed suction to introduce an acceleration toward the wall, thereby preventing the occurrence of centrifugal separation. Fig. 2 shows a flow similar to that in Fig. 1, except that in Fig. 2, suction pressure was applied to three lines of holes around the periphery of the nose, through which air was sucked.[8] It is evident that the flow is completely attached to the wall of the duct. In fact, the flow is seen to be converging into a narrow tube, having extremely high velocities near the wall.

It is this very problem of flow acceleration near the wall of the duct which has resulted in rather poor results being obtained with conventionally twisted propellers when placed in ducts.

Twist Distribution for Ducted Propellers

Velocity distributions across the propeller plane were measured for two differently twisted propellers in the same duct.[9] One was a conventionally twisted propeller originally used in the AG-14 airplane as a pusher. The twist was such that the blade setting at the 0.66 radius point was 4.2 deg larger than that at the tip. The other, a modified twisted propeller, was similar to the former except that it was made of constant chord and constant angle to within 0.9 radius, where the twist was gradually increased to 7 deg at the tip.

The conventionally twisted propeller suffered from separated flow occurring on the inlet and passing through the propeller. As a result, the peak velocity through the duct was much lower than with the positively twisted blade. The propeller was operating in this separated flow with its tips stalled.

As far as the influence on the flow on the wall of these same two propellers mounted in the same duct is concerned, the modified twist propeller develops a much higher thrust on the duct. This results, since the integral in the axial direction of the pressure distribution on the duct is the value of the thrust of the duct.

In plotting the propulsive efficiency and the coefficient of thrust against advance ratio, the positively twisted (modified-twist) propeller has a distinct advantage over the speed range measured. It should also be mentioned that it is entirely possible by additional research to improve still further the performance of the ducted propeller throughout its speed range by utilizing the modified-twist concept.

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[6] H. M. Claybourne, "Study of a Shrouded Propeller With Distributed Suction on the Inlet Profile," Mississippi State University, Aerophysics Department, Research Report No. 24, December 10, 1958.

[7] Where U = velocity of flow, fps; g = gravitational constant, 32.2 fps per sec; and R = local radius of curvature of wall, ft.

[8] Dr. Maekawa was Fulbright Research Professor at Mississippi State University, 1957–1959; Physics Department, University of Hiroshima, Japan.

[9] D. E. McNay, "Study of the Effects of Various Propeller Configurations About a Shroud," Mississippi State University, Aerophysics Department, Research Report No. 14, February, 1958.

Fig. 3 The AG-14, a typical experimental airplane on which a ducted propeller was found to yield a large performance improvement in take-off and climb

Diffuser on Inside Duct

After having designed the proper inlet, and having adjusted the propeller twist to match the resultant inflow velocity profile, one problem of the ducted propeller remains: The diffusion of the flow behind the propeller. If the velocity energy of the flow can be recovered as pressure applied to the inclined inner wall of the diffuser, one can gain in static thrust for the same power expended in the propeller. The theoretical thrust per hp was plotted versus hp per sq ft, for the conventional open propeller, for a ducted propeller of zero diffusion, for the duct with moderate diffusion, before mentioned,[6] and for a highly diffused duct which was a modification of the former. Therefore a considerable gain can be made in static thrust if the diffuser flow can be maintained attached. Perhaps by using distributed suction on the diffuser, it would be possible to achieve this gain.

However, to date, such high diffusion ratios on a ducted propeller have not proved useful. In fact, for a STOL airplane, the higher-diffusion-ratio duct must inevitably result in a higher drag in cruising flight.

Practical Applications

A typical experimental airplane on which a ducted propeller was found to yield a large performance improvement in take-off and climb is shown in Fig. 3. The duct consisted of an NACA 4415 airfoil modified to a cambered elliptic nose of eccentricity 2.5:1. With the modified-twist propeller, the static thrust was 560 lb, using a 90-hp engine. Originally, the open propeller of conventional twist developed a thrust of 265 lb.

The improvement in take-off and climb was quite significant since thrust at low speed almost doubled.

However, the cruising performance was not significantly improved because the conventional tail as well as the duct added to the over-all drag at high speeds. The total thrust for the duct shown in Fig. 3, even at advance ratios up to $\lambda = 0.3$,[10] is better when a modified-twist propeller is used.

New Design

When the ducted propeller is utilized in an original design to take advantage of its best features, the airplane shown at beginning of this paper is arrived at. Here the ducted propeller is used as a pusher, the duct providing stabilization and control in pitch and yaw. In addition, the airplane shown uses high-lift boundary-layer control, achieved by means of suction through distributed perforations.

Since the static thrust of the ducted propeller driven by a 250-hp gas turbine will be around 1800 lb for an airplane gross weight of 2200 lb, a thrust-to-weight ratio of 0.82 will be attained. Having such a thrust-to-weight ratio means that the airplane can take off on skids from any type of surface—runway, grass, mud, ice, or snow, and even plowed fields—with an acceleration of at least 0.4 g. Landing in unprepared fields is made quite safe by the use of skids long enough to bridge ditches, and holes, and even cross furrows.

Later on in a development of the STOL known as the "Marvel," research now being carried on will permit the marriage of the high-lift-suction boundary-layer-control system with low drag-suction boundary-layer control. Such a combination will permit this airplane to fly at 500 mph on 250 hp at 20,000 ft, whereas without this combination low-drag and high-lift system, the top speed at 20,000 ft is 350 mph.

Since its landing and take-off will be done at 35 mph, using high-lift boundary-layer control, very short fields will suffice. Estimates of take-off distance over a 50-ft obstacle from grass fields show that the total distance should be around 150 ft. Landing will be a corresponding distance.

Conclusion

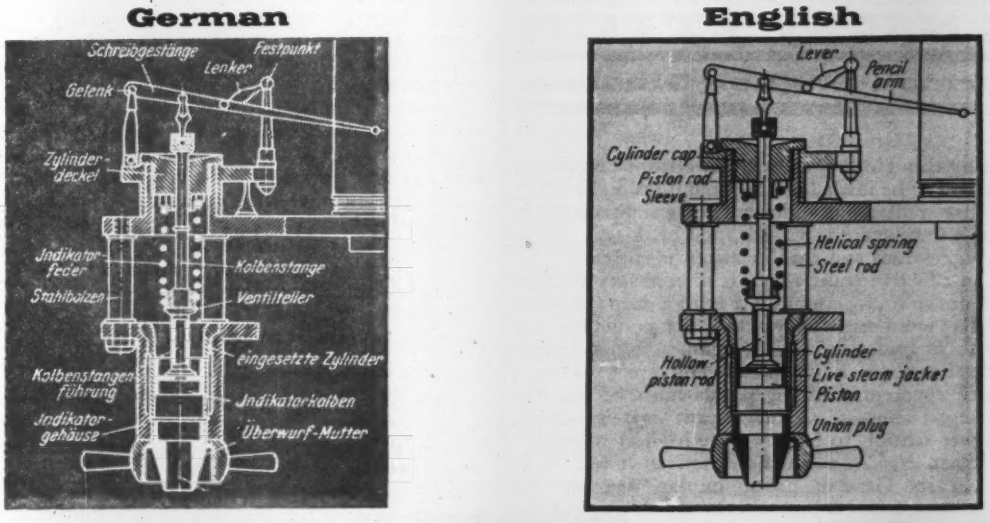
The ducted propeller provides an ideal propulsor for STOL airplanes utilizing high-lift boundary-layer control of an energy-conservative type.

Design of a ducted propeller for STOL application involves the correct design of the entry contour as well as correct matching of propeller-pitch distribution to the inflow velocity distribution at the propeller plane.

Having designed the ducted propeller with these two considerations, only the problem of diffuser ratio at the aft end of the duct remains. The choice here depends on the airplane speed ratio. Additional research on this aspect should permit a rational choice.

What recommends the ducted propeller for a high-performance STOL airplane is its multiple function of propulsor, stabilizer, and control element. In addition, the freedom from turbulent flow over the fuselage and wing permits the pusher-ducted STOL to attain high cruising speeds on moderate power.

[10] The propeller advance ratio $\lambda = \frac{v}{\eta D}$, where v = forward speed, fpm; η = propulsive efficiency, defined as $\frac{Tv}{\text{hp}}$ where T = thrust, lb.



KINEMATICS

A German-English Glossary

By **R. S. Hartenberg,**[1] Mem. ASME, **and T. P. Goodman,**[2] Assoc. Mem. ASME

The German literature of kinematics grows in importance. This glossary aids in making German investigations accessible to English-speaking engineers.

THE increasing use of automatic machinery emphasizes the importance to the machine designer of obtaining complex machine motions with minimum dynamic disturbance. A substantial part of the ever-increasing literature of kinematics is of German origin. Access to this material, hampered by the presence of the extensive vocabulary inherent in any specialized field, is complicated by being in an unfamiliar tongue and is hindered by the lack of standard terminologies in either English or German.

This glossary of some of the most frequently used terms of the German papers has been compiled to make that material more accessible. Elements of arbitrariness are present—they have been unavoidable—because of the lack of standardization. It was necessary to review and judge. When more than one English equivalent is given for a German word, the first is the preferred choice.

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Language Is Fluid

Any language has a certain fluidity, due in part to regionally preferred forms, a consequence of simultaneous growth in widely separated localities. The result is a vocabulary of terms, understood locally but looking odd to the stranger. Even the English and American languages have their differences; to an Englishman, *corn* is any edible small grain (this is the German's *Korn*); *maize* (German *Mais*) corresponds to the American idea of corn. The piece of furniture called *bureau* is for writing or storing linen, depending on the English or American viewpoint. With such conflicts existing between two languages so often held to be the "same," the presence of a completely different language as the source of translation provides no easement.

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Presenting this glossary is thus not without its perils. Decisions had to be made, and the compilers realize only too well that readers will differ in choice and preference. The reader's indulgence is sought, and his kindly aid in terms of suggestions and amplifications is entreated.

To do an effective translation, it is necessary to have some idea of the topic, coupling it with a deep suspicion founded on word-sensitivity, and compounding the whole with imagination. A straight dictionary translation may produce a completely incorrect concept. Even many apparently simple words must be handled with feeling. Thus, *Hochschule* means *any* university; it is a higher school, to be sure—the highest there is—but it is not a *high school* in the American sense. *Konstrukteur*[3] in its German flavor implies *designer*. To render it as *constructor* (as most dictionaries do) gives the wrong idea, for the designer works in the office and on the board, the constructor being active in the shop or on the building site. Some words having only a slight variation in spelling are self-evident, as *Komponente* and *Resultante*. There seems to be no rule covering this situation.

[3] A historic example of this confusion was provided by Suplee, who in his 1894 translation of Reuleaux's *Konstrukteur* called it *Constructor*. The book deals with machine elements and design; it was meant for the office and not the shop.

German engineers use *Taschenbücher*, i.e., our *handbooks;* the word-for-word *pocketbooks* applies to at least a couple of other objects. One of the compilers, while in charge of a group of Air Force translators—qualified because they "knew German" (they had no knowledge of aeronautics, however)—was presented with *adjusting screw* for *Verstellschraube*. The German word, under dictionary dissection, will produce *adjusting screw*, perfectly correct at times. However, the context of the article demanded *constant-speed propeller*—even *adjustable-pitch*, *variable-pitch*, and *controllable-pitch* were each wrong. In another case, *Fallschirmjäger*, via the dictionary's one-to-one, came out *parachute hunter* (one thinks of duck hunter!); the compound word is actually *paratrooper*, the translator having been insensitive to the fact that *Jäger* has also the army meaning of *infantryman*.

A Special Vocabulary

This glossary presents a special vocabulary not found in dictionaries. However, some words that properly belong to a general vocabulary have been included, either because of the difficulties mentioned above or the convenience deriving from frequent appearance. The glossary may be considered only as a supplement to one or more standard dictionaries. No grammatical problems are discussed. It should be remarked that the German β is given by the alternative spelling ss. Thus *Maß* becomes *Mass*. When a word with an *ss* ending is coupled with another starting with an *s*, awkwardness is relieved and uncertainty increased by allowing *s* to appear only twice, e.g., *Mass* plus *Stab* becomes *Masstab*. This dumping of letters is not unique to German, for *where* plus *ever* is written *wherever*, certainly confusing to someone whose English is weak.

GLOSSARY

A

Abänderung: change, modification
Abbildung: figure, illustration
  konforme **Abbildung:** conformal mapping (*in complex-variable theory*)
abgestumpft: dulled, blunted, truncated
abhängige Grösse: dependent variable
Ableitung: derivative of a function, derivation
Abmessung: dimension
Abminderung: reduction
Abstand: common perpendicular of two axes; distance, spacing, interval (compare Kreuzungsabstand)
Abszissenachse: abscissa axis
Abtrieb: output
  Abtriebsglied: output link, driven link
Abweichung: deviation, error
Achse: axis
Ähnlichkeit: similarity, similitude
Anfangsstrahl (eines Winkels): initial side of an angle
Angelpunkt: centering point
  Angelpunktkurve: centering-point curve, centering curve, pivot-point curve, anchor curve
Annäherung: approximation
  angenähert: approximate
Annahme: assumption
Antrieb: input
  Antriebsglied: input link, driving link
Arbeitsgang: working stroke
Ast: branch. Same as Zweig.
Aufgabe: task, problem
Aufriss: elevation view (compare Riss, Grundriss, Seitenriss)
Augenblickspol = augenblicklicher Drehpol: instantaneous center of rotation, velocity pole
Ausgleich: compensation, adjustment
  Ausgleichsgetriebe: differential mechanism
AWF = Ausschuss für Wirtschaftliche Fertigung: Committee for Economical Production

B

Bahn: path, trajectory, trace
  Bahnkurve: path, trajectory
  Bahnstelle: position on the path
Bedingung: condition
Begriff: concept
Beilage: supplement
Beispiel: example
Beitrag: contribution
Beiwert: coefficient, factor, parameter
beliebig: arbitrary, any designated
Berührung: contact, touch
Beschleunigung: acceleration
  Beschleunigungsplan: acceleration vector diagram
  Beschleunigungspol: acceleration pole, acceleration center
  Beschleunigungszustand: state of acceleration
  Winkel**beschleunigung:** angular acceleration
Betrag: magnitude
Bewegung: motion
  Beweglichkeitsgrad: number of degrees of freedom; degree of movability
  Bewegungsüberlagerung: superposed motion
  Bewegungsübertragung: motion transfer
  Dreh**bewegung:** rotational motion; turning motion
  Schub**bewegung:** translational motion
  Wälz**bewegung:** combined rolling and sliding motion (*of surfaces in contact*)
Bezugsachse: reference axis
binär: binary
Blindleistung: circulating power (in a planetary drive)
Bogen: arc
  Bogeneinheit: radian
  Bogenmass: measurement in radians
  Bogenschubkurbel: crank-and-rocker mechanism (*four-bar linkage with rotating input crank and oscillating follower*)
Bolzen: bolt, "pin connection"
Bremse: brake
  bremsen: to apply brakes
Brennpunkt: focus, focal point
Büschel: pencil (*as pencil of rays, etc.*)

C

Cardan: see Kardan

D

Darstellung: representation
Differentialquotient: derivative
DIN = Deutsche Industrie Normen: German Industrial Standards
Doppelantrieb: double input

Doppelkurbel: drag-link mechanism (*four-bar linkage with rotating crank and rotating follower*)
Doppelschieber: inversion of Scotch-yoke mechanism where the yoke is the frame; elliptic trammel
Doppelschleife: inversion of Scotch-yoke mechanism where the crank is the frame
Drall: moment of momentum
Drehbewegung: rotational motion, turning motion
Drehgelenk: turning pair, revolute
Drehschubgelenk: turning and sliding pair, cylindric pair
Drehpaar: turning pair, revolute pair
Drehpol: center of rotation
Drehwinkel: angle of rotation
Drehzahl: number of revolutions per unit time (*usually rpm*)
Dreibinder: bell crank, ternary link
Dreistabgetriebe: four-bar linkage
Druckkraftorgan = Flude: incompressible fluid as link
Durchmesser: diameter, diametral line
Durchmesserteilung: diametral pitch
Durchschlagslage = Verzweigungslage: folded position (*e.g., the position of a four-bar linkage in which the center lines of all four links are coincident*)
durchschlagendes Getriebe: folding linkage (*a linkage capable of assuming a folded position*)

E

Ebene: plane
ebenes Getriebe: planar mechanism
Eigenschaft: property
Einheit: unit of measurement
Eingriffsglied: follower (*in a cam mechanism*)
Eingriffslinie: line of action
Eingriffswinkel: pressure angle
Einschränkung: restriction, limitation
einwandfrei: completely satisfactory, exemplary, without objection
einzigartig: unique
elastisch: elastic
Endstrahl (eines Winkels): terminal side of an angle
Endlage: final position
entartet: degenerated
entsprechend: corresponding
Ersatzgetriebe: equivalent mechanism, substitute mechanism
Ersatzmasse: equivalent mass
Ersatzkette: equivalent kinematic chain
Erzeugende: generatrix
Evolute: evolute
Evolvente: involute
Kreisevolvente: involute of a circle

F

Fachwerk: structure (*i.e., kinematic chain with zero degree of freedom*)
Faustformel, Faustregel: rule of thumb
Feder: spring, spline, pen, feather
Federgetriebe: spring-actuated mechanism
fern: distant
Fernpunkt: point at infinity
festigkeitsgerecht: properly proportioned for stress and strain
Feststellung: fixing, immobilization
Fläche: area, surface, plane
Flachriementrieb: flat belt drive (*depends on context*)
Flansch: flange
Flaschenzug: block and tackle
Fliehkraftregler: flyball governor
Flude = Druckkraftorgan: incompressible fluid as link
Formel: formula
Formschluss: form closure (cf. Kraftschluss)
Forschung: research
Forschungsanstalt: research establishment
Freiheit: (degree of) freedom
Freiheitsgrad: number of degrees of freedom
Führung: guidance
Fusszeichen: subscript (compare Kopfzeichen)

G

Ganghöhe = Steigung: lead (of screw)
Gauss-sche Zahlenebene: complex number plane
Gebiet: region, domain, field (*of study*), range (*of curve*)
gegen den Uhrzeigersinn: counterclockwise
gegenläufig: moving in opposite directions (compare gleichläufig)
Gegenpol: opposite pole, complementary pole, contrapole
Gegensinn des Uhrzeigers: counterclockwise direction
Gegenpolviereck: opposite-pole quadrilateral
gekröpft: cranked, offset, bent
Gelenk: pair, joint
Drehgelenk: turning pair, revolute pair
Drehschubgelenk: turning and sliding pair, cylindric pair
Gelenkgetriebe: linkage having only turning and sliding pairs
Gelenkpunkt: center of moving joint
Gelenkviereck: four-bar linkage
Kugelgelenk: ball-and-socket joint, spheric pair
Schubgelenk: rectilinear sliding pair, prismatic pair
Siebengelenkgetriebe: seven-joint linkage (*i.e., a linkage having six links with seven joints*)
Viergelenkgetriebe: four-bar linkage
gerade: even (*number or integer*) (compare ungerade)
Gerade: straight line
Geradführung: straight-line mechanism, straight-line guidance
Geradschubkurbel: slider-crank mechanism (*with rectilinear slider*)
schwingende **Geradschubkurbel:** inversion of slider-crank obtained by fixing slider
Gerät: device, piece of equipment, agricultural implement
geschränkt: offset (*adjective*)
Geschwindigkeit: velocity, speed (*depends on context*)
Geschwindigkeitsplan: velocity vector diagram
Geschwindigkeitszustand: state of velocity
Winkel**geschwindigkeit:** angular velocity
gedrehte **Geschwindigkeit:** rotated velocity vector
Gestänge: linkage of bars
Gestell: fixed link, frame (*of mechanism*)
Gestellpunkt: center of pivot on frame
Gestellglied: fixed link
Getriebe: mechanism, mechanical transmission
Getriebedynamik: dynamics of mechanisms
Getriebelehre: theory of mechanisms, kinematics
Getriebesynthese: synthesis of mechanisms, kinematic synthesis
Getriebetechnik: technology of mechanism design
Gewinde: thread (*of screw*)
gewöhnlich: ordinary, usual, common
gleichförmig: uniform
gleichförmige Übersetzung: uniform transmission (see Übersetzung)
gleichförmig übersetzendes Getriebe: uniform transmission (see Übersetzung)
Gleichgewicht: balance, equilibrium
gleichlaufend, gleichläufig: moving in same direction (cf. gegenläufig)
gleichschenklig: isosceles
Gleichung: equation
gleiten: to slide (*without turning*)
Gleitschiene: crosshead guide, slide bar or rod
Gleitstein: crosshead (*translating*), slide block
Gleitstange: slide rod
Glied: link (*of mechanism*), term, element, member, component, limb
goniometrisch: trigonometric
Grad: degree
Grenzübergang: passage to the limit; limiting process
Grösse: quantity, variable, parameter
Grössenordnung: order of magnitude
Grundriss: plan view (compare Riss, Aufriss, Seitenriss)
Güte: quality, efficiency

H

Halbierungspunkt: mid-point
Halbmesser: radius
Hebel: lever
Herz = Hz: frequency in cycles per second
Hilfsmittel: aid
hinreichend: sufficient
Hochschule: any university, but usually, an Institute of Technology
Hodograph: hodograph
örtlicher **Hodograph:** local hodograph
polarer **Hodograph:** polar hodograph
Hodograph der gedrehten Geschwindigkeiten: hodograph of rotated velocity vectors
Höhenschnittpunkt: orthocenter (*intersection of the three altitudes*) of a triangle
Hooke-sches Gelenk: Hooke's universal joint
Hub: stroke
Hüllbahn: envelope
Hüllkurve: generating curve (*of envelope*)

I

Istwert: present or actual value (compare Sollwert)

K

Kante: corner
Kardanbewegung: Cardan motion (*motion for which the fixed and moving centrodes are both circles, with the fixed centrode located inside the moving centrode and having half the radius of the moving centrode*
Kardangelenk: Hooke's universal joint
Kardankreis: Cardan circle (*one of the two circles which form the centrodes in a Cardan motion*)
Kardanlage: Cardan position (*a position of a link for which the radius of curvature of the fixed centrode is twice that of the moving centrode, with both radii in the same sense*)
Kegel: cone
Kegelrad: bevel gear
Kegelschnitt: conic section
Kegeltrieb: bevel-gear drive
Kehrwert: reciprocal value
Keil: wedge
Keilkette: wedge chain
Keilriementrieb: V-belt drive
Kenngrösse: parameter
Kennmass: characteristic
Kenntniss: knowledge
Kennziffer: coefficient, numerical characteristic
Klinke: latch, pawl
Klinkenschaltwerk: ratchet mechanism
Kniehebelgetriebe: toggle mechanism
koaxial: coaxial
Kolben: piston
Kollineationsachse: collineation axis
komplan: coplanar
Komponente: component
konaxial: coaxial
Konstrukteur: designer, **not** constructor or builder
Konstruktion: design, **not** construction or building
Koordinate: co-ordinate
Koordinatenursprung: origin of co-ordinates
Kopfzeichen: superscript (cf. Fusszeichen)
Koppel: coupler, connecting rod
Koppelgetriebe: mechanism in which the output link is driven from a coupler point of a four-bar linkage
Koppelkurve: coupler-point curve, coupler curve
Koppelpunkt: coupler point

KINEMATICS

A German-English Glossary

Kraft: force
  Kräftepaar: force pair, couple
  Kraftschluss: force closure (compare Formschluss)
Kreis: circle
  Kreisbüschel: pencil of circles
  Kreispunkt: circle point
  Kreispunktkurve: circle-point curve
  Kreisschiebung = Scheuerbewegung: circular translation
  Kreisungspunkt: circling point
  Kreisungspunktkurve: circling-point curve, frame-pivot curve
Kreuz: cross
  Kreuzgelenk: Hooke's universal joint
  Kreuzgelenkkupplung: Hooke's universal joint
  Kreuzkopf: crosshead
  Kreuzschleifenkette: Scotch-yoke chain
  Kreuzschubkurbel: Scotch-yoke mechanism
  Kreuzungsabstand = Abstand: common perpendicular of two axes
  Kreuzungswinkel: angle between axes
Krümmung: curvature
  Krümmungshalbmesser: radius of curvature
  Krümmungskreis: osculating circle
  Krümmungsmittelpunkt: center of curvature
Kugel: sphere, bullet, ball
  Kugelgelenk: ball-and-socket joint, spheric pair
Kulisse: slot, crosshead guide
  Kulissenstein: crosshead
Kupplung: clutch, coupling
Kurbel: crank
  Doppel**kurbel**: drag-link mechanism (*four-bar linkage with rotating input crank and rotating follower*)
  Kurbelgetriebe: crank mechanism
  Kurbelschleife: inversion of slider-crank mechanism
  Kurbelschleife, schwingende: inverted slider-crank mechanism with coupler as frame
  Kurbelschleife, umlaufende: inverted slider-crank mechanism with crank as frame
  Kurbelschwinge: crank-and-rocker mechanism (*four-bar linkage with rotating crank and oscillating follower*)
  Kurbeltrieb: linkage having only turning and sliding pairs. (cf. Kurbelgetriebe, Gelenkgetriebe)
  Schub**kurbel**getriebe: slider-crank mechanism
Kurve: cam, curve
  Kurvengetriebe: cam mechanism
  Kurvenscheibe: disk cam
  Kurvenscheibengetriebe: disk-cam mechanism

L

labil: labile, **unstable, in** indifferent equilibrium (*can mean either "in unstable equilibrium" or "in indifferent equilibrium," depending on the context*)
Laboratorium (often abbreviated as Labor): laboratory
Lage: position; location
  endlich benachbarte **Lagen**: distinct positions, finitely separated positions
  unendlich benachbarte **Lagen**: infinitesimally close positions
Lagenwinkelzuordnung: co-ordination of positions and angles
Lager: bearing
Leistung: power, performance
  Blind**leistung**: circulating power (in a planetary drive)
Leitstrahl: focal radius, focal ray
linksgewunden: left-handed
lose = los: loose, free, unattached (*adjective*)
  Lose: looseness, backlash, slack (*noun*)
Lot: perpendicular (*noun*)
  lotrecht: perpendicular, vertical (*adjective*)
Luft: play, clearance

M

Malteserkreuzgetriebe: Geneva mechanism
Mass: measure, extent
  Masstab = Mass-stab: scale, measure, criterion, standard
  Masssynthese = Mass-synthese: dimensional synthesis
Masse: mass
  Massenausgleich: mass-balancing
mehrfach: manifold, multiple
Mittel: mean or average, means
  Mittelpunkt: center point
  Mittelpunktkurve: center-point curve, midpoint curve
  Mittelsenkrechte: perpendicular bisector, midnormal
mittelbar: indirect (compare unmittelbar)
Momentanpol: instantaneous center of rotation, velocity pole
Mutter: nut (*of bolt or screw*)

N

nähern: to approach
  Nährerung: approximation
Nenner: denominator of a fraction (cf. Zähler)
Nocken: cam
  Nockenscheibe: disk cam
  Nockenwelle: camshaft
Nut, Nute: slot, groove, key-seat
  Nutkurve: cam with groove

O

Ortskurve: locus curve
örtlich: local
örtlicher Hodograph: local hodograph

P

Paar: pair, connection
P.S. = Pferdestärke: metric horsepower = 0.986 US hp
Plan: plan, diagram
Pleuelstange: connecting rod. (Same as Schubstange, Koppel)
Pol: pole, center of rotation, virtual center of rotation
  Drehpol: center of rotation
  Momentan**pol**: instantaneous center of rotation, velocity pole
  Poldreieck: pole triangle
  Polgerade: pole line (*connecting two instantaneous centers: the straight line of the theorem of three instantaneous centers*)
  Polwechselgeschwindigkeit: pole velocity (*velocity with which the location of the instantaneous center changes*)
  Pollagenkurve: pole locus curve, pole position curve, pole curve
Polbahn: centrode, polode (*path of instantaneous centers*)
  Gang**polbahn**: moving centrode, moving polode
  Rast**polbahn**: fixed centrode, fixed polode
Punkt: point
  Punktlage: point position
  Punktlagenreduktion: point-position reduction
  Punktlagenzuordnung: co-ordination of point positions
Punktbahn: trajectory

Q

Quaternär: quaternary
Querschnitt: section

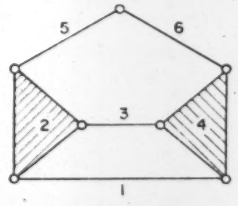
R

Rad: wheel
Radiant (rd): radian
Radlinie: ordinary cycloid
Rast: dwell
  Rastgetriebe: dwell mechanism
  Rastpolbahn: fixed centrode, fixed polode (cf. Gangpolbahn)
Raum: space
  Raumgetriebe: spatial mechanism
  Raumkinematik: spatial kinematics
Rechenmaschine: computer
Rechenschieber: slide-rule
rechnerisch: analytically, by computation
Rechteck: right angle
rechtsgewunden: right-handed
rechtwinklig: rectangular
Regel: rule
Regler: governor, regulator, control
Reibung: friction
  Reibbremse: friction brake
  Reibkupplung: friction clutch
  Reibrad: friction wheel
  Reibungszahl: coefficient of friction
Relativpol: relative pole, relative center of rotation (*of two moving links*)
Resultante: resultant
Richtung: direction
  Richtungssinn: sense
Riemen: belt
  Flach**riemen**: flat belt
  Keil**riemen**: V-belt
  Riementrieb: belt drive
Riss: view (*projection*); crack, scratch
Ruck: jerk, pulse (*sudden change in acceleration*)
Rückgang: return stroke
Rückkehrkreis: return circle, cuspidal circle
  Rückkehrpol: return pole, cuspidal pole, return center
Rundlingspaar: turning pair, revolute pair

S

Satz: principle, law, theorem, sentence, sediment
Schalter: switch
  Schaltgetriebe: ratchet mechanism
  Schaltrad: ratchet wheel
Scharnier: turning pair, revolute pair, hinge
Schaubild: diagram, schematic
Scheibe: disk, slice, pane, pulley
Scheitel: vertex, crown
  Scheitel eines Winkels: vertex of an angle
Schenkel: side or leg of angle
Scheuerbewegung = Kreisschiebung: circular translation
Schieber: translating part, as crosshead, reciprocating cam follower
  Schiebepaar: sliding pair, prismatic pair
  Schiebung: translational motion
schief: skewed
Schleife: slide, loop
Schluss: end, finish, closure
Schmiegungskurve: osculating curve
Schnecke: worm of worm-gear
  Schneckengetriebe: worm-gear mechanism
  Schneckenrad: worm wheel
  Schneckentrieb: worm-gear drive
Schnelligkeit: speed (*magnitude of velocity vector*)
Schnittpunkt: intersection
schraffiert: cross-hatched
Schrägverzahnung: helical gearing
Schränkung: offset (*noun*)
  geschränkt: offset (*adjective*)
Schraube: screw, bolt, propeller
  Schraubenlinie: helix

Schrotung: instantaneous helical motion
Schubbewegung: translatory motion
Schubgelenk: rectilinear sliding pair, prismatic pair
Schubkurbelgetriebe: slider-crank mechanism
Schubstange: connecting rod. (Same as Pleuelstange, Koppel)
Schwerpunkt: center of gravity
Schwinge: oscillating crank or follower, rocker
schwingendes Glied: oscillating link
Schwingung: vibration
Sehne: chord
Seileck: string or funicular polygon
Seitenriss: side view (compare Riss, Grundriss, Aufriss)
senkrecht: vertical (*adjective*)
Senkrechte: perpendicular, vertical (*noun*)
Skala: scale
Sollwert: theoretical or nominal value (compare Istwert)
Sonderfall: special case
Spannvorrichtung: clamping device
Spannwerk: spring device for energy storage and release
Sperrgetriebe: ratchet mechanism, locking mechanism
Sphäre: sphere
sphärisches Getriebe: spherical linkage (*a linkage whose links move on the surface of a sphere, the axes of the turning pairs intersecting at the center of the sphere*)
Spiegelung: reflection, image
Spiegelpol: image pole
Spitzenwinkel: vertex angle
spitzer Winkel: acute angle
stabil: stable
Standglied: fixed link, frame (*of mechanism*)
Standwechsel: kinematic inversion (*interchange of fixed and moving links*)
starr: rigid
Stechzirkel: dividers
Steg: fixed link, frame (*of mechanism*)
Steigung: lead of screw, grade of a roadbed
Stephenson-scher Mechanismus: a six-bar linkage having the configuration shown (compare Watt-scher Mechanismus)



stetig: continuous
steuern: to regulate or control
Stift: dowel pin
Kegelstift: taper pin
Stirnrad: spur gear
Storchschnabelgetriebe: pantograph
Stoss: impulse (*sudden change in velocity*)
Strahl: ray, jet
Strahlenbüschel: pencil of rays
Strecke: line, interval, line segment, distance
Stück: rod, bar
stumpfer Winkel: obtuse angle

T

Tangentialkreis: Bresse circle, tangential-acceleration circle
Taumelscheibengetriebe: wobble-plate mechanism, swashplate mechanism
Teilung: pitch of gear
Teilkreis: pitch circle (*of gear*)
ternär: ternary
Thetalinie = ϑ Linie: line giving the linear velocity distribution of a rotating link
Totlage: dead-center position
Tracke = Zugkraftorgan: belt or chain as link
träge: slow, sluggish, possessed of inertia
Trägheit: inertia
Trägheitshalbmesser: radius of gyration
Trägheitskraft: inertia force
Trägheitsmoment: moment of inertia
Trägheitsradius: radius of gyration
Typensynthese: type synthesis

U

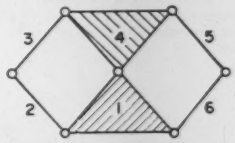
übergeschlossenes Getriebe: overclosed mechanism, mechanism with redundant constraints
überlagert: superimposed
Überlagerung: superposition, coincidence
Übersetzung: velocity ratio; transmission, gear box (*as in an automobile*)
gleichförmige **Übersetzung**: transmission with constant velocity ratio
ungleichförmige **Übersetzung**: transmission with varying velocity ratio
Übersicht: survey
Übertragungswinkel: transmission angle (*complement of pressure angle*)
Uhrzeigersinn: clockwise direction
Umdrehung: rotation
Umdrehungskörper: body of revolution
Umfang: circumference, perimeter, girth
Umfangsteilung: circular pitch
umkehren: to invert or reverse
Umkehrung: inversion
Umlauf: complete rotation
Umlaufbedingung: condition for complete rotation
umlaufendes Getriebe: rotating mechanism (*with output link capable of 360° rotation*)
umlaufendes Glied: rotating link (*capable of 360° rotation*)
Umlaufgetriebe: planetary gear mechanism
Umlaufzeit: period (*of cycle*)
Umstand: circumstance
unendlich: infinite
ungerade: odd (*number or integer*), (compare gerade)
ungleichförmig: non uniform
ungleichförmige Übersetzung: transmission with varying velocity ratio (compare Übersetzung)
ungleichförmig übersetzendes Getriebe: transmission with varying velocity ratio (compare Übersetzung)
unmittelbar: direct, immediate (cf. mittelbar)
Unterlage: data, support, base, foundation

V

V D I = Verein Deutscher Ingenieure: Society of German Engineers
V D M A = Verein Deutscher Maschinenbau Anstalten: Society of German Machine Builders
Vektorzug: vector diagram
veränderlich: variable (*adjective*)
Veränderliche: variable (*noun*)
Veranschaulichung: representation, pictorialization
vereinfacht: simplified
Verfahren: method(s), process(es)
Verhältniss: proportion, relation
Verschleiss: scuffing, wear due to rubbing
verstellbar: adjustable
Verstellbarkeit: adjustability
Verstellgetriebe: control mechanism
Versuch: test, trial, experiment
Versuchsanstalt: testing laboratory
Versuchsergebnisse: test results
Verwendung: use, application
Verzahnung: gearing
Verzögerung: deceleration, retardation
Verzweigungslage: folded position (compare Durchschlagslage)
Vieleck: polygon
Viereck: quadrilateral
Viergelenkgetriebe: four-bar linkage
Viergelenkkette: four-link chain,
Voraussetzung: assumption

W

wagerecht: horizontal
Wahrscheinlichkeit: probability
Wahrscheinlichkeitsrechnung: theory of probability
Wälzbewegung: combined rolling and sliding motion (*of surfaces in contact*)
Wälzhebelgetriebe: direct-contact mechanism
Wälzlager: roller bearing
Watt-scher Mechanismus: a six-bar linkage having the configuration shown (*not to be confused with the Watt straight-line mechanism*)



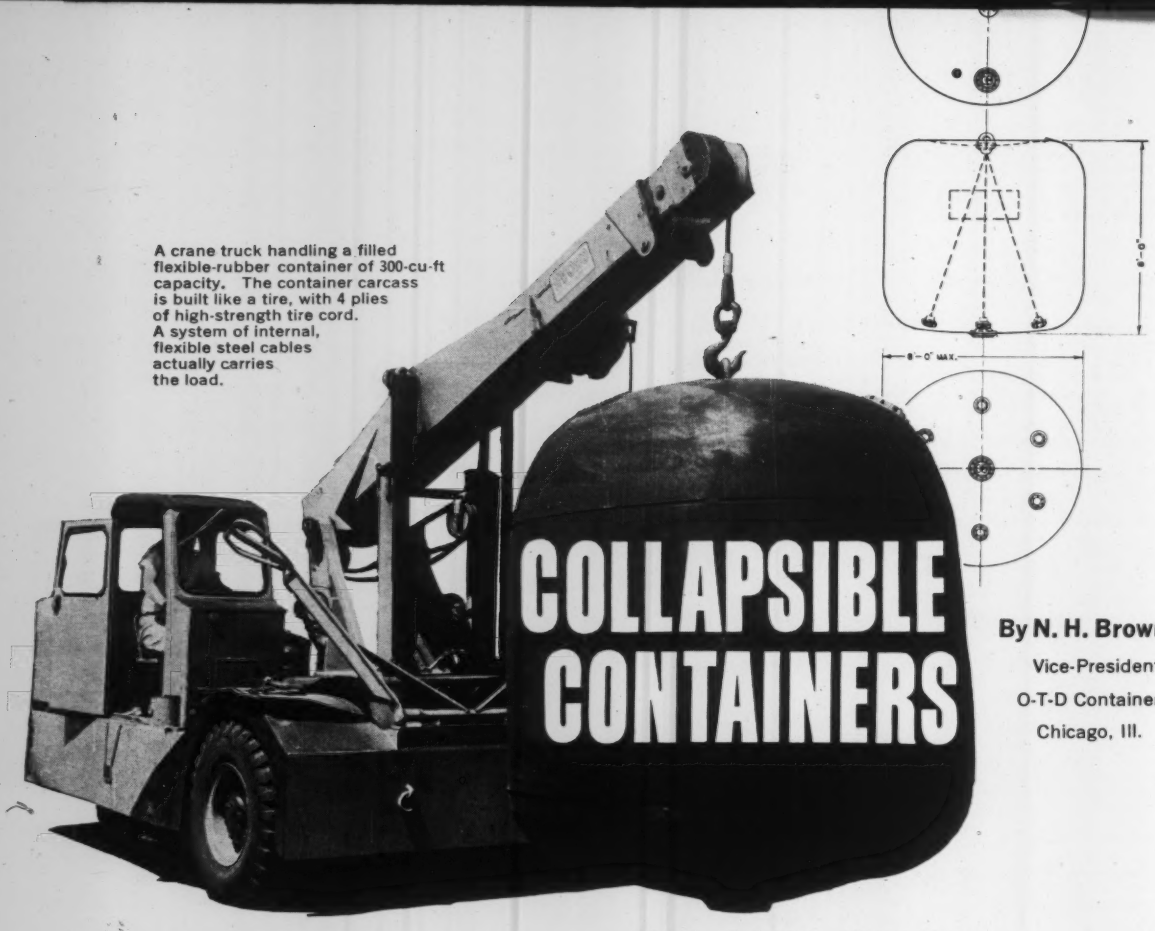
Weg: displacement
Welle: shaft, axle, wave
Wendekreis: inflection circle
Wendepol: inflection pole, inflection center
Wendepunkt: inflection point
wider: against, resisting
Widerstand: resistance
wieder: again
willkürlich: arbitrary
windschief: skewed
Winkel: angle
Winkelbeschleunigung: angular acceleration
Winkelgeschwindigkeit: angular velocity or speed (*depending on context*)
Winkelmesser: protractor
schiefer **Winkel**: oblique angle, i.e., any angle not a right angle
spitzer **Winkel**: acute angle
stumpfer **Winkel**: obtuse angle
Wippkran: a level-luffing crane consisting of a four-bar linkage and exploiting a coupler-point curve
Wirkungsgrad: efficiency
Wirkungslinie: line of action

Z

Zähler: numerator of a fraction (compare Nenner)
Zahlsynthese: number synthesis
Zahnrad: gear
Zahnstange: rack
Zapfen: element of full journal, pivot, turning pair, revolute pair, trunnion peg, spigot
Zapfenerweiterung: expansion of turning pair
zeichnerisch: graphical
Zeiger: pointer
Zeitschrift: periodical
zentrisch: radial (*i.e., not offset*)
Zerfall: degeneration
Zirkel: circle, draftsman's compass
Zugkraftorgan = Tracke: belt or chain as link
Zuordnung: co-ordination
Lagenwinkel**zuordnung**: co-ordination of positions and angles
Punktlagen**zuordnung**: co-ordination of point positions
zugeordnete Punkte: co-ordinated points, corresponding points
Zusammenhang: relation, connection
zusätzlich: additional
Zustand: state
Zwanglauf: constrained motion
Zweck: aim, purpose, object
Zweig: branch
Zweigstelle: branchpoint
Zweistandgetriebe: linkage with two frame joints, two-pivot linkage

Acknowledgment

The compilers of this Glossary gratefully acknowledge the assistance and valuable suggestions of J. Denavit, F. Freudenstein, A. S. Hall, B. L. Harding, and I. E. Morse.



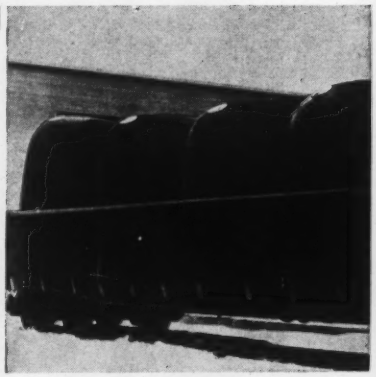
A crane truck handling a filled flexible-rubber container of 300-cu-ft capacity. The container carcass is built like a tire, with 4 plies of high-strength tire cord. A system of internal, flexible steel cables actually carries the load.

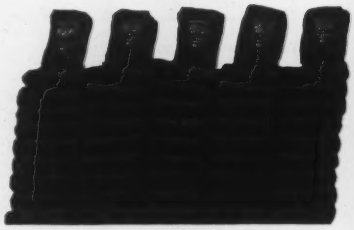
COLLAPSIBLE CONTAINERS

By N. H. Brown, Jr.,
Vice-President,
O-T-D Container Corp.,
Chicago, Ill.

Made of rubber, like a tire.

Flexibility is the new dimension offered by this shipping container—plus adaptability.





A COLLAPSIBLE CONTAINER which was first used commercially in the early 1950's is now broadening into a variety of packages manufactured by several companies. This is the collapsible rubber container for dry, flowable products. From this basic container idea evolved a concept of bulk-material movement which includes packaging, storage, transportation, and quality stabilization. The parallel for the handling of liquids is progressing rapidly.

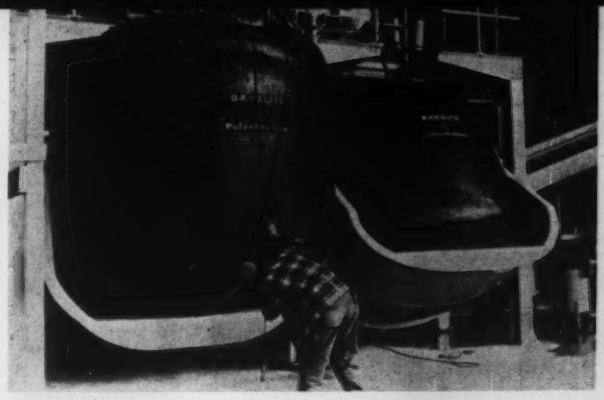
The container system possesses the same competitive advantages as did the paper bag, since any and all types of carriers—and combinations of carriers—can be used (as against older-type bulk-shipping or receiving installations which are frequently limited to a single mode of transportation). Containerization has reduced transfer costs by as much as 80 per cent, and combination rates are now providing attractive savings.

Another element is the return of the empty bulk unit. Here, the true efficiency lies in the collapsibility of the container, which permits utilization of the transportation equipment for a revenue-bearing return haul.

The container may serve as a warehouse and storage bin.

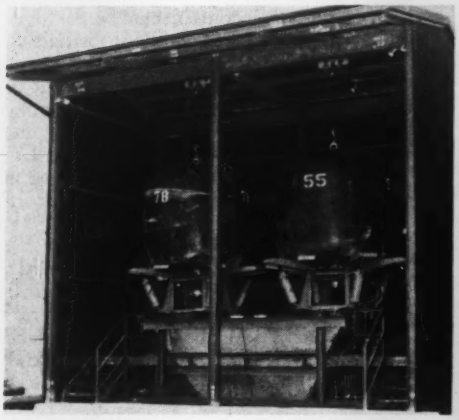
For dry, flowable products (sugar, starch, flour, and plastic resins are typical), the next decade will witness an evolution in distribution concepts. Why should the housewife in Columbus, Ohio, have to pay for a multiply, vapor-barrier package for sugar that was packaged in New Orleans and has incurred expensive handlings before reaching the grocery shelf? Why shouldn't she push a button and have a dispenser weigh out and package the sugar in an inexpensive box or bag—a dispenser serviced by a bulk-shipping container?

Contributed by the Rubber and Plastics Division and presented at the Rubber and Plastics Conference, Erie, Pa., Oct. 9–12, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from paper No. 60—RP-4.



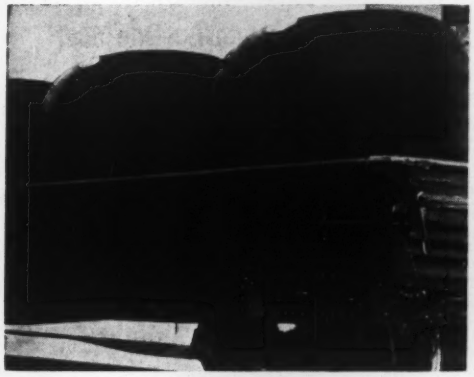
LOADING
For loading by gravity, the empty container is placed in a cradle and tilted to about 40 deg, so that the filling port, which is off center at he top, becomes the high point. The container is first inflated with 8 to 12 oz of pressure to extend the walls. It is lifted by an exterior lifting eye at top center, which connects with the internal steel cables.

UNLOADING
Since the container is almost 8 ft in diam, with 6 or 8-in. emptying port, it needs a mechanical unloading device. The unloader consists of 8 paddle-shaped arms radiating from a center opening. These rise so as to form a conical bottom, enabling every bit to flow out. If a vibrator is needed, it can be mounted on one of the unloader arms.

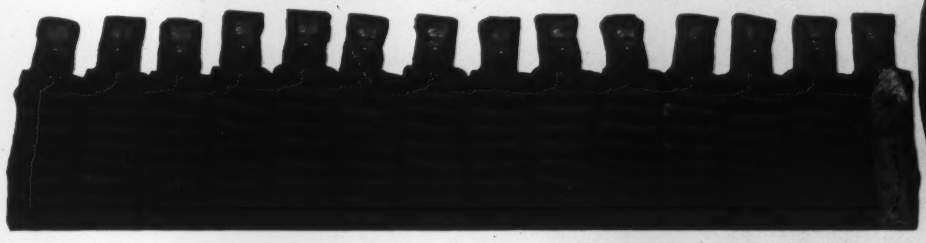


EMPTY
One truck can return the collapsed containers of a 30-truck shipment. The other 29 can return with revenue-producing freight.

ON THE MOVE
Below left: Shipment by standard railroad gondola car. These collapsible containers are designed for transport by all carriers in their standard open equipment, which is generally their lowest-cost equipment. **Lower right:** The containers in a standard open-top truck.



FIVE POUNDS, PLEASE
The 300-cu-ft container with an equivalent volume of carbon black in 50-lb paper bags. Soon, the housewife, buying a commodity such as sugar, may push a button on a dispenser which will weigh out the sugar into an inexpensive box or bag, the dispenser serviced by one of these bulk containers.



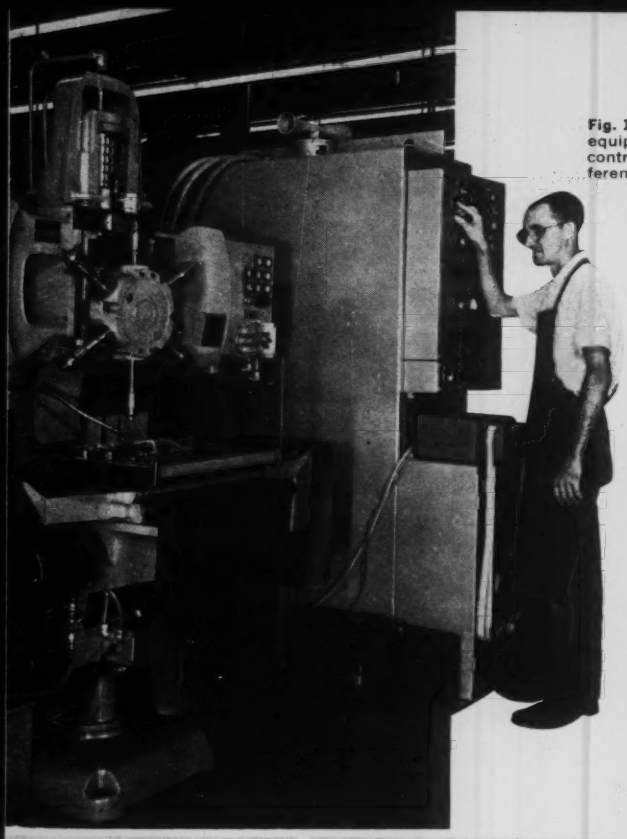


Fig. 1 A six-spindle turret-type drilling machine, equipped with two-motion numerical-positioning control, eliminated the need for 124 different drill jigs which cost about $1500 each

Are You Considering

Do you know what numerical control can do for you? One user

By James A. Baker, Specialty Control Department, General

By 1965, 50 per cent of all machine tools purchased will be numerically controlled. It is time to consider what numerical control can do for your plant.

Numerical control can be divided into two types by definition—numerical-contouring control, where the path of the tool is controlled continuously, and numerical-positioning control for point-to-point positioning where the path between points is not controlled. Milling machines and various turning machines offer ideal applications for contouring control. Drilling and boring machines, punch presses, and some milling machines are good applications for numerical-positioning control.

Where Numerical Control Is Used

There are now in service, mostly in the aircraft industry, approximately 150 machines equipped with numerical-contouring control. The industry as a whole expects to sell about 100 new machines in 1960 of the continuous-path type. High initial cost and relatively difficult programming techniques for contouring control have kept sales at a fairly low level, but new control and programming techniques promise to make contouring control practical for the small shop from both an initial price and programming standpoint.

The machines best suited for numerical-contouring control are: Engine lathes, knee-type milling machines, vertical boring machines, and horizontal boring machines.

All have been equipped with numerical-contouring control and all are available now as a packaged product from machine-tool builders.

An indication of the savings to be expected from con-

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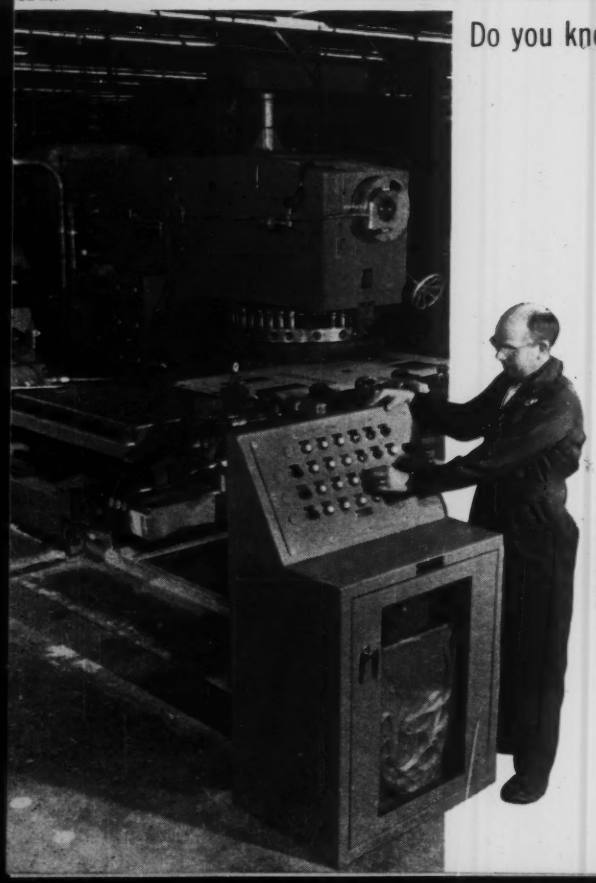


Fig. 3 Wiedematic turret-type punch press is equipped with three-motion numerical positioning and has 30 different punches in the rotary turret. It is saving $42,000 yearly in general punching duty. It is used on plates up to 100 × 60 × 3/8 in.

Fig. 2 Horizontal boring machine equipped with three-motion numerical positioning and automatic tool changer has saved up to 60 per cent in floor-to-floor time

Electric Company, Waynesboro, Va.

touring control is pointed out by one aircraft company's experience. Over 1000 hr were cut from tool design and fabrication at the sacrifice of 19 hr in production-planning time. Parts are now being made by numerically controlled milling machines that could not be made any other way.

But numerical-control contouring is only a small part of the story. The second type of control, numerical positioning, is the one you will most likely see in your plant first. Today there are approximately 400 machines in production, and about 900 new machines equipped with numerical-positioning control will be put in service in 1960. They range from a simple single-spindle drilling machine with two controlled motions up to a 15-motion specially designed milling machine.

The reports of savings realized from these machines range from mediocre to fantastic. One user saved enough money on his drilling machine to pay it off in 4 months. Typical users of these machines are paying them off in approximately 2 to 3 years.

The punch press shown in Fig. 3 is equipped with 30 different punches in the rotary turret. This machine is saving $42,000 yearly in general punching duty on plates up to 100 × 60 × $^3/_8$ in.

The layout drilling machine shown in Fig. 4 is intended for working dies, jigs, fixtures, molds, and other tools to an accuracy of ±0.001 in. Production time was cut on the part shown from 7 hr to 50 min.

Fig. 5 shows a versatile milling, boring, and drilling machine equipped with automatic tool changing. The machine will mill, drill, bore, counterbore, tap, and read with practically no unproductive time in the machine cycle. On one group of six different parts, tooling savings per part ranged from a low of $870 to a high of $2800. Quantities varied from 30 to 120 parts with production time savings ranging from 54 to 375 hr. The greatest savings were made on the shortest runs.

What It Can Do for You

The experience of the past six years has conclusively

Numerical Control?

saved enough on his machine to pay it off in four months. Two to three years is typical.

Numerical-positioning control finds an ideal application on machines such as the six-spindle drilling machine shown in Fig. 1. This particular machine eliminated the need for 124 different drill jigs at an average cost of $1500 each. The cost of the jigs is not surprising when you consider that there are 2400 holes per part in three pinhole sizes, with a required accuracy of ±0.002 in. between holes. This machine eliminated the need for special tooling costing six times the machine and control investment.

The horizontal boring machine in Fig. 2 is one of three working in a large Rocky Mountain manufacturer's plant. The machine changes tools automatically and has saved up to 60 per cent in floor-to-floor time on various steel parts. This type of machine is an unusually good application for numerical control.

proved that numerical control properly applied can save a great deal of money. Of the many possible savings, three are of particular concern to a job-shop operation: (*a*) Special-tooling costs and lead time; (*b*) machine utilization and worker productivity; and (*c*) consistent high-quality production.

Take a mental inventory of the jigs and special fixtures in your shop, adding both cost and storage space. These are virtually eliminated with numerical control. On one part working only nine holes, the jig for a standard drilling machine cost $1300. With numerical control the cost was $20 for a simple holding fixture. The savings from tooling alone may often justify the purchase of numerical control.

As bonus savings from this tooling reduction, manufacturing lead times are reduced by the amount of tool-

Fig. 4 Layout drilling machine equipped with two-motion numerical positioning cut working time on dies, jigs, fixtures, molds, and other tools from 7 hr to 50 min. Accuracy is within ± 0.001 in.

Fig. 5 Milwaukee-matic milling, drilling, boring machine equipped with three-motion numerical positioning and automatic tool changing saves from $870 to $2800 per part and from 54 to 375 hr per part

room time formerly needed to produce special tooling. Even in relatively simple jobs, typical reductions are 1 to 8 hr. On complex parts this lead-time factor may be even more significant with reductions in lead-time from 1 to 6 weeks. Since the knowledge previously stored in a jig is now stored in a tape, expensive storage space is greatly reduced. Numerical-positioning-control punched tapes for approximately 50 jobs can be stored in 2 cu ft.

The second major problem, and one of the greatest, is machine utilization. With conventional equipment, change-overs from one part to another may take days and even weeks, just setting up templates, fixtures, or what have you. A machine-utilization factor of 30 per cent may even be considered as pretty high.

Accompanying this utilization factor there is a worker-productivity figure which keeps getting more important every year. Over the past seven years, average hourly earnings have gone up over 50 per cent, but worker productivity has increased only 15 per cent. This squeeze on profits, which is of major concern to all industry management, is making new methods like numerical control a must.

Prior to the installation of the numerical-positioning-controlled welder in Fig. 6, it took 16 man-hours to make the 1600 welds required to complete one part—and the incidence of scrap was correspondingly high. Now it takes one man less than 5 min to load the part and push the start button—1 hr 20 min later he takes it off, an improvement in time of 11 to 1. In the meantime he's productively engaged on another machine. Numerical-positioning control not only provides the needed flexibility for the many different designs run here, it increases output and worker productivity and stops scrap. With savings of $26,000 a year, the investment paid off in two years and is now in its fifth year of operation.

In the average machine shop there is a variety of machines, and most parts require several types of work, such as contour milling, drilling, boring, and so on. Thus to produce one lot of parts, two or more machines commonly have to be scheduled. This costs extra money in two ways—additional setups, and waiting time between machines. Parts, half finished, sit on the floor in tote boxes or on pallets waiting for a machine. The waiting time may be hours, or it may be days, with a sizable investment tied up.

The answer to this problem is a machine equipped with numerical control which can do a variety of jobs on a part with one setup.

There are many examples of increased productivity from numerical control. Positioning feed rates are increased from 10 to 150 ipm. Location of holes is automatic—jobs are completed on the machine in minutes instead of hours. Long setups and nonproductive machine times are cut. Machines are not only operating faster, but are making chips more of the time, and the investment is paying for itself faster. Individual-worker productivity is not merely raised a few percentage points, it is increased severalfold, the profit squeeze is eased.

But all these benefits are only potential benefits unless reliable, consistent, accurate operation is insured. The mere fact that a co-ordinate table can be moved at several hundred inches per minute means nothing unless it can be moved and stopped, *every time*, at the position called for. This is the third major point—numerical control *does* give consistent and accurate performance.

Dependable accuracies mean better parts, less inspection, a smaller quality-control department, and dollar savings.

The importance of demanding only those accuracies that are really needed should be emphasized. All too often it is forgotten that numerical control will provide the accuracy previously specified and at the same time double or triple production. When some people decide to do the job automatically, they insist on accuracy twice as great as they were satisfied with before. The cost to give such accuracy increases very rapidly. Specify only true needs and insist that they be met.

What Is Its Maintenance History?

There seems to be an almost universal fear of "complex controls" among those who have not yet used numerical control. This problem of complexity is really a matter of comparison conditioned by time or familiarity. Just 10 or 12 years ago television was a new electronic monster that seemed so complex that insurance policies were purchased with sets, and TV repairs mushroomed overnight. Just a little familiarity with numerical controls will remove a lot of this complex fear.

One larger user of numerical control (18 machines) has stated that the problems encountered were qualitatively no more complex than those experienced with the first advanced welding equipment. Another user states that many of the troubles anticipated in the use of numerically controlled machines never appeared.

A survey was made of 32 users of two-motion controls with over six-months' operating experience. Although seven indicated start-up problems, follow-up showed that four were machine problems and of the remaining three, only one could be considered a real problem.

The average operating time was 64 hr per week and

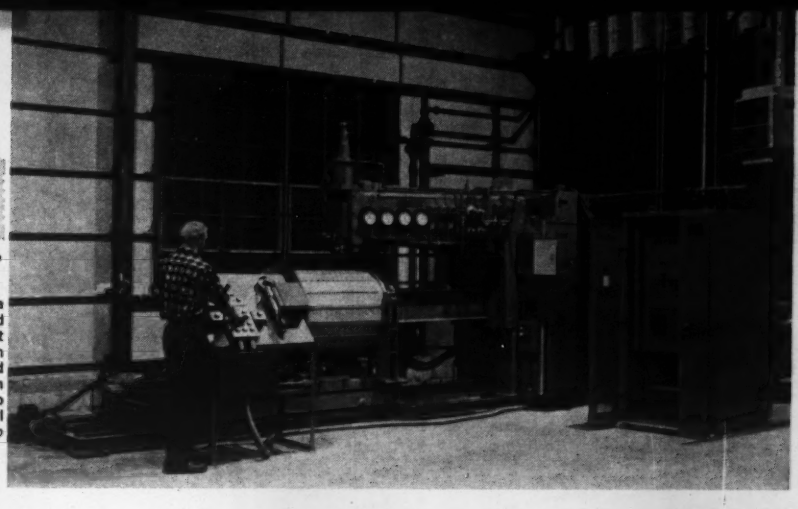


Fig. 6 With one man, a welding machine used on jet-engine-exhaust liners and equipped with numerical control showed an 11-to-1 improvement in the time needed to complete a typical part and saved scrap

the average down time per week was less than 4 hr. From this survey it was found that the average maintenance man was an electrician with some brief electronic training. He was also a high-school graduate with no college training. Most users had an average of eight preventative-maintenance checks per year, each check taking an average of 2 hr.

Early this year the General Electric Company initiated a service contract that can be purchased with the control. This service contract offers 24-hr service on emergencies and 4 preventative-maintenance checks per year. Renewal parts to cover 80 per cent of all problems are included as a part of the plan. Free service schools of 4-day duration are also held quarterly for those users wishing to send maintenance people.

Machine and control manufacturers are doing everything possible to make these machines work correctly. But there are still misapplied lemons even though they are rare and are corrected as quickly as possible.

What Are the Problems?

It would be nice to say that there are no problems with numerical control, but there are some.

One beginning problem is the difficulty of justifying the relatively high cost of numerically controlled machines. Increased production and greater accuracy are only part of the story. All areas of savings must be looked at closely. These are: Direct labor, indirect labor, overhead, setup time, overtime, fringe benefits, outside-work charges, scrap, spoilage, and rework, tooling and tool repair, inspection, maintenance, down time, material handling, inventory, floor space, power, taxes, and insurance. This is an imposing list, but all are factors to be considered. Numerical control is *not* practical for every job.

Programming has been a problem on contouring control and to a much lesser degree on positioning control. Basically the programming of drilling-and-punching positioning control requires no new techniques or skills. A manufacturing drawing is replaced with a column of numbers which a typist copies on an automatic typewriter. Training for this job requires only a few minutes. However, programming of contouring control is not so simple, and sometimes needs the help of a computer. To cope with these problems in contour programming, a number of companies and associations have combined their efforts and knowledge to simplify contour-part programming.

Computer subroutines are being worked out to cut down on the amount of information to be given the computer.

There is no reason to fear the programming of numerical-positioning control. *You can handle it!*

A thorough study should be made of any contouring control to assure yourself that you understand what is involved. It is not complicated if you have the tools.

With the number of systems and various types of tape for input that have been introduced in the past six years, a problem of standardization can plague you if the systems are not compatible, although diligent efforts are being made to standardize tape sizes and tape codings. Already, 1-in-wide, eight-channel punched tape of paper or Mylar construction has become pretty well established. Cards and wide tapes used at first have proved to be generally unsuitable. The problems of handling cards in the factory and of punching the wide tapes were too costly.

The control system should be checked to see that it meets your requirements.

There are other minor problem areas such as maintenance (already mentioned), labor relations, machine loading, and readjustment of personnel. All are insignificant in the light of the savings involved, and the author knows of no installation adversely affected by labor problems. Numerical control will eliminate problems, rather than cause them.

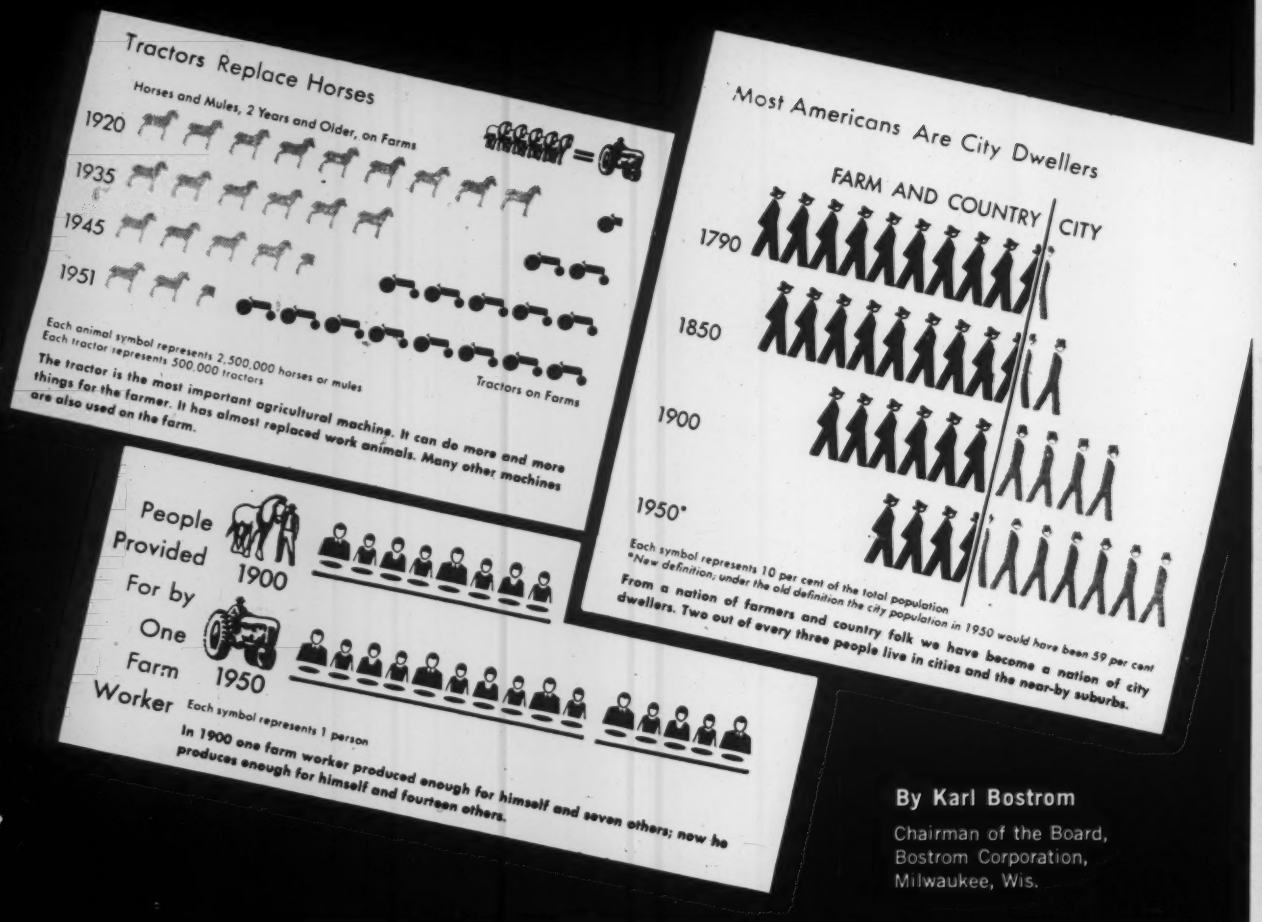
What About Backfitting Old Machines?

Experience has proved that *in most cases* backfitting a machine in your shop is *not* the most economical answer in the long run. Extensive rebuilding is frequently required, which, for all practical purposes, may be as expensive as buying a new machine and it is difficult to know if dependable accuracy can be built into the machine.

Remember, it takes more than just putting a jet engine into a Piper Cub to make a supersonic airplane. To realize the full capabilities of numerical control, the machine needs to be designed for numerical control.

The Future

The prediction that 50 per cent of all machine tools built in 1965 will have numerical control tells only part of the story. New machines will mill, drill, bore, tap, grind, and turn. A part will be completely machined on one machine. These machines are not in the dream stage. Some are already being tested. The possibilities are limited only by imagination. The automated factory for small-lot production is now possible with numerical control. *Your* future is tied up in a piece of tape. Investigate what numerical control can do for you.


Tractors Replace Horses
Horses and Mules, 2 Years and Older, on Farms
1920
1935
1945
1951
= Tractors on Farms
Each animal symbol represents 2,500,000 horses or mules
Each tractor represents 500,000 tractors
The tractor is the most important agricultural machine. It can do more and more things for the farmer. It has almost replaced work animals. Many other machines are also used on the farm.
Most Americans Are City Dwellers
FARM AND COUNTRY
CITY
1790
1850
1900
1950*
Each symbol represents 10 per cent of the total population
*New definition; under the old definition the city population in 1950 would have been 59 per cent
From a nation of farmers and country folk we have become a nation of city dwellers. Two out of every three people live in cities and the near-by suburbs.
People Provided For by One Farm Worker
1900
1950
Each symbol represents 1 person
In 1900 one farm worker produced enough for himself and seven others; now he produces enough for himself and fourteen others.

By Karl Bostrom

Chairman of the Board,
Bostrom Corporation,
Milwaukee, Wis.

PRODUCTIVITY

THE United States of America, with only 6 per cent of the world's population and 7 per cent of the land area, is free and is still the world's greatest democracy because our engineers and our supporting technicians created 50 per cent of the world's factory production and 40 per cent of the world's income for our people.

Management can sit in its executive suites and labor can make its increasing demands only because you have created a social surplus. Greece and Rome had its human slaves, but you have created 100 mechanical slaves for every man, woman, and child in the United States.

When we talk shop among ourselves, we say our engineering has lowered costs, produced more units per hour, or raised the quality of the materials, products, or services we work with. Usually this is also translated in terms of money and profit.

Social Surplus—Time Left Over

But the fundamental effect of what we do can be summed up in this simple sentence: "If you finish the job sooner, you have time left over to do something else." It is the time which is left over that counts.

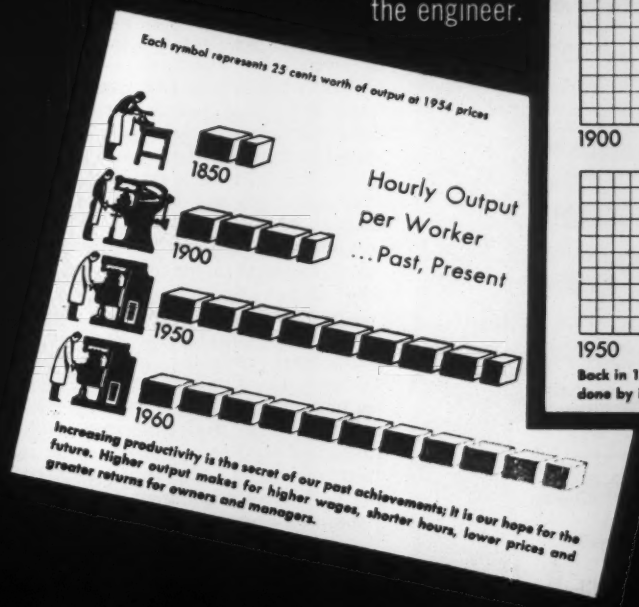
It was the time left over in the use of spears, fish hooks, nets, and other hunting tools with which man found time to develop agriculture and advance the use of fire. With the time left over, man put to use his brain, the greatest tool in creation. It is this time, this social surplus as it is called, that has created his cultures and civilizations and preserved for man the technologies for the next generation.

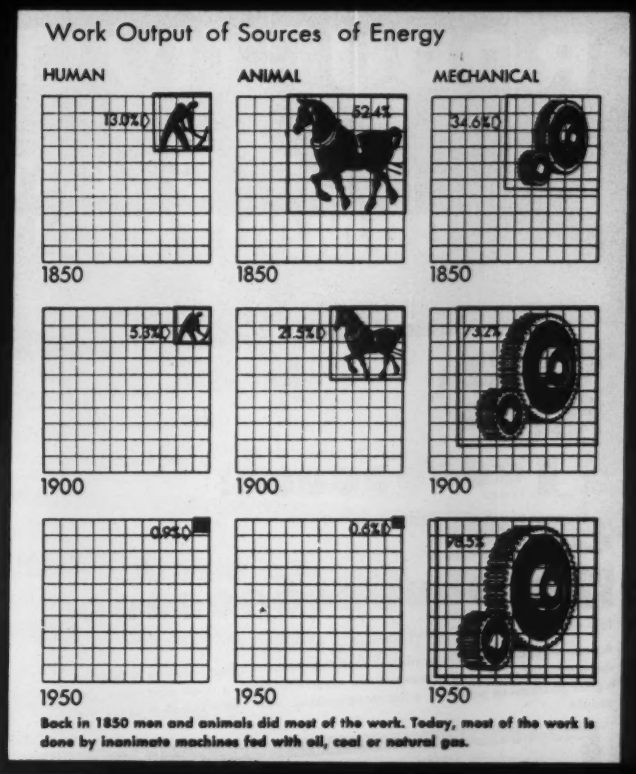
Culture Follows Technology

With few exceptions our universities and colleges still place commerce and industry as low man on the cultural totem pole. Few writers, artists, or literary men pay much at-

Contributed by the Production Engineering Division and presented at the Production Engineering Conference, Milwaukee, Wis., May 17–19, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 60—Prod-16.

Productivity is the basis of "social surplus" —which translates as spare time —enabling men to engage in study, to advance their thinking. Back of modern productivity is the engineer.


Each symbol represents 25 cents worth of output at 1954 prices
1850
1900
1950
1960
Hourly Output per Worker ...Past, Present
Increasing productivity is the secret of our past achievements; it is our hope for the future. Higher output makes for higher wages, shorter hours, lower prices and greater returns for owners and managers.



—THE GREAT COMMITMENT

tention to the technology and science which has given them the leisure to go their esoteric ways. Although there has been some improvement in recent years, our historians still fail to emphasize the central position of technology. Sometimes, as in the battle between the *Merrimack* and the *Monitor*, the contribution was so fantastic that it could not be ignored, but the key factors of technology, as it applied to weapons, transportation, food, and so forth, got short shrift. This occurred despite the fact that yesterday, as today, our political and military leaders enter the history books because of the social and economic problems created by advancing technology.

But the harsh light of world conditions is entering even the cell of the cloistered scholar. The social surplus which permits him the leisure for his studies can only be maintained by advancing technology. There is now abroad another system which appears determined to make the technological leap by making every man, woman, and child participate directly in their five and seven-year plans whether he likes it or not.

Once we were a nation bordered by two vast oceans and without enemies on its northern or southern borders. Those oceans have disappeared.

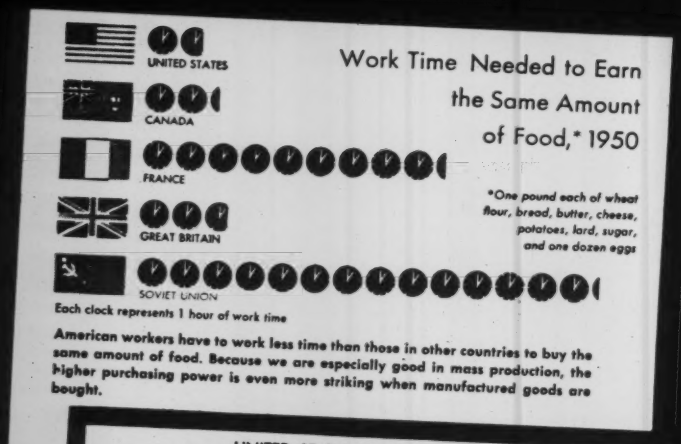
Today we live in a world which can be circumplaned by jet in three and one-half days or less. And, an enemy missile can reach us in thirty minutes.

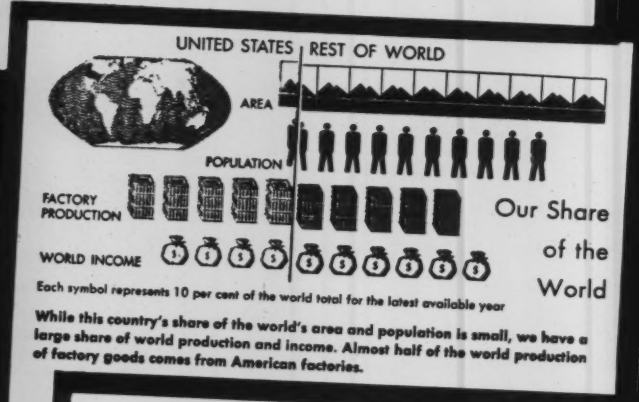
The World Arena

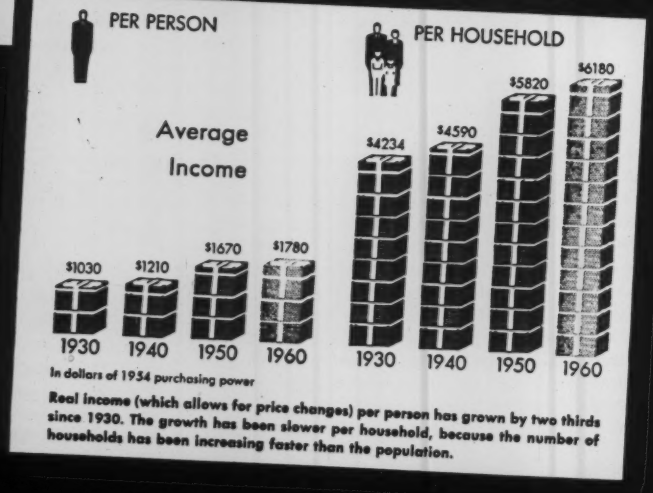
This fantastic achievement of technology in a brief 100 years has placed us in the center of the world arena. Tier on tier some two billion, one-hundred million spectators watch and evaluate every facet of our way of life. They are also watching our antagonist who has a slightly higher population than ours and is not as far advanced in his over-all technology as we are.

Among the spectators are one billion, five-hundred million people of illiterate and hungry races and nations. Few, if any of them, can understand our banners telling about democracy and freedom. What they are interested in is human dignity and opportunity—a place in the

PRODUCTIVITY —THE GREAT COMMITMENT


Work Time Needed to Earn the Same Amount of Food,* 1950
UNITED STATES
CANADA
FRANCE
GREAT BRITAIN
SOVIET UNION
*One pound each of wheat flour, bread, butter, cheese, potatoes, lard, sugar, and one dozen eggs
Each clock represents 1 hour of work time
American workers have to work less time than those in other countries to buy the same amount of food. Because we are especially good in mass production, the higher purchasing power is even more striking when manufactured goods are bought.


UNITED STATES
REST OF WORLD
AREA
POPULATION
FACTORY PRODUCTION
WORLD INCOME
Our Share of the World
Each symbol represents 10 per cent of the world total for the latest available year
While this country's share of the world's area and population is small, we have a large share of world production and income. Almost half of the world production of factory goods comes from American factories.



sun. They can get this only through education and then by technology. They want time left over after their daily struggle for food, shelter, and clothing.

Another group of spectators, about six-hundred million, have democracy and freedom. Only they understand the banners we display. And, only as long as we show leadership will they remain our allies.

Let us not be fooled. The primary challenge, as the hungry billion and a half see it, is not freedom, democracy, the private-enterprise system, the missiles we shoot up in the sky, or even our hydrogen warheads. Nor does capitalism and communism have any real meaning to them. But, only through what we do, and then by showing them how we can help them raise their standards, will they cheer us and be on our side. Only then.

They must achieve in fewer years what we have achieved in the past 100 years.

The illustrations shown here, taken from The Twentieth Century Fund book entitled "USA in New Dimensions—The Measure and Promise of America's Resources,"[1] graphically portray the American technological revolution. This book in turn was a brief and graphic summary of the Fund's monumental study on America's resources and needs.

"We Will Bury You"

Khrushchev said he would bury us. The real meaning of his statement was not immediately appreciated, and many do not understand even now. What he said in effect was that the Soviet Union, supported by its growing elite of engineers, scientists, and technologists, under their planned explosion of productivity and scientific discovery, would bury our power and prestige in the eyes of the rest of the world. In other words, his system by deeds and example is out to win the support of the world. Moreover, he said our grandchildren would also live under their type of system.

While their military technology largely remains a secret from us, the basic weapons with which they hope to capture the world, while lulling us into a mood for peaceful coexistence, are fully published and may be read by all.

Most people think that we need only to catch up with the missile

[1] The Macmillan Company, New York, N. Y., 1957.

race and develop some antimissile missiles, and our job will have been done. If we do no more than this, we will still have lost the race.

We will lose the race unless we undertake a vast program of increasing productivity through technology and underwritten by a vast expansion of the education of our children and adults, not only to understand what is taking place in our shrunken world but to participate directly in the race of technology. To win the race for freedom we must have a program as comprehensive as our military effort in World War II.

Our Real Capital

Let me quote from one of our most accepted management thinkers, Peter F. Drucker, who in his "Landmarks of Tomorrow"[2] says:

"... When economists talk of 'capital' they rarely include knowledge. Yet this is the only real capital today. The development of educated people is the most important capital formation, their number, quality, and utilization the most meaningful index of the wealth-producing capacity of a country."

If then we are to maintain our free way of life, it is obvious there must be an enormous increase in our productivity to sustain these programs of education and defense. We must bring support to the underdeveloped countries through education and technology. This is the challenge we face.

None of these things will become possible unless we in commerce and industry first provide the time and social surplus by which others may carry out those programs which will sustain and further develop our role as leaders of the free world.

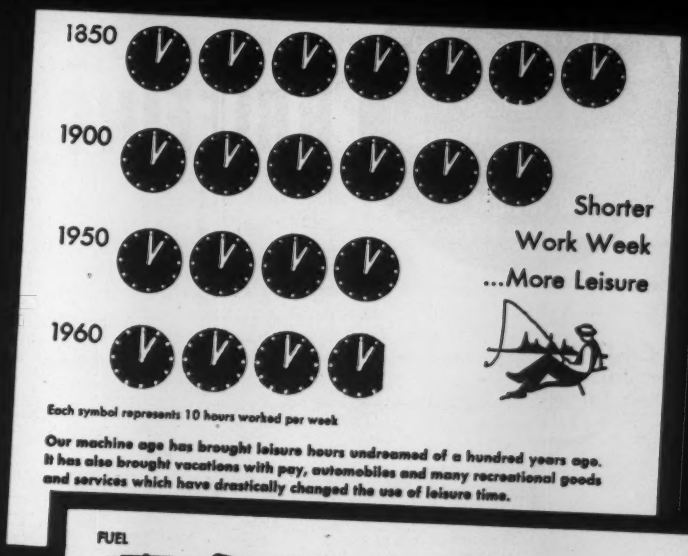
Here we as technologists must play our roles as citizens in our community. As specialists in industry and commerce who appreciate the tools of increasing productivity, we must share with our fellow citizens the appreciation of the job that can be done and must be done.

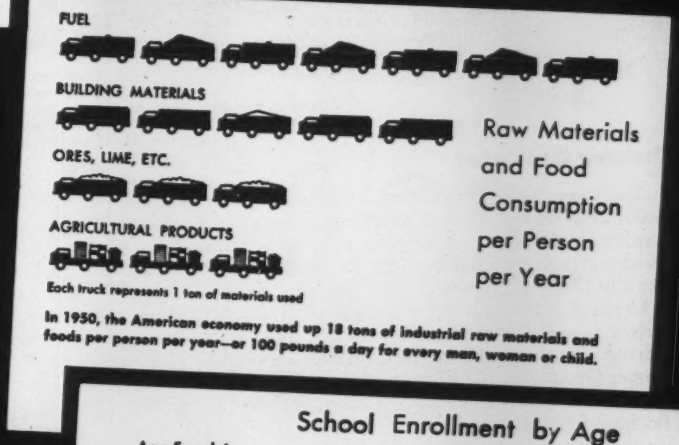
But first we ourselves must see the light. We must clearly see with a burning dedication and a deep conviction the role we must play.

We technologists are the ones who, by increasing national productivity, create that social surplus, that time for others to do their allotted tasks in the titanic challenge we now face.

This is the great commitment.

[2] Harper and Brothers, New York, N. Y., 1959.

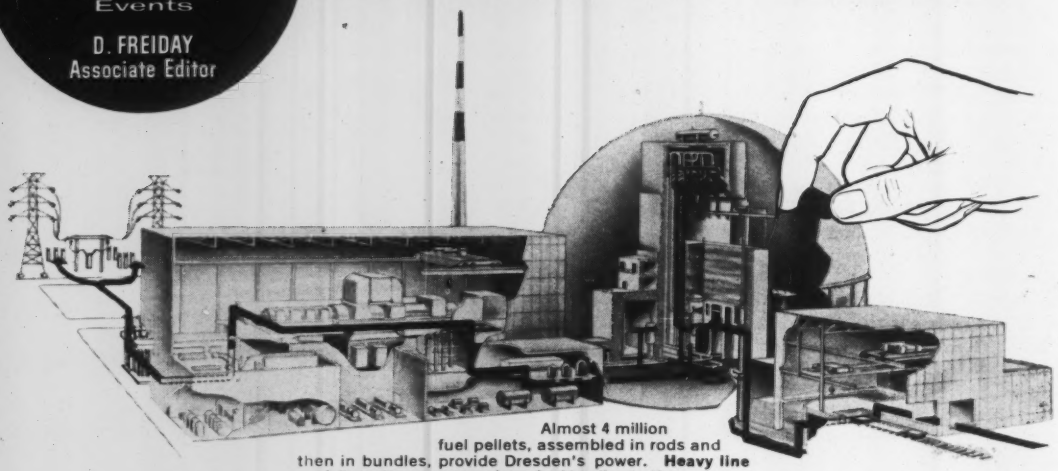

1850
1900
1950
1960
Shorter Work Week ...More Leisure
Each symbol represents 10 hours worked per week
Our machine age has brought leisure hours undreamed of a hundred years ago. It has also brought vacations with pay, automobiles and many recreational goods and services which have drastically changed the use of leisure time.


FUEL
BUILDING MATERIALS
ORES, LIME, ETC.
AGRICULTURAL PRODUCTS
Raw Materials and Food Consumption per Person per Year
Each truck represents 1 ton of materials used
In 1950, the American economy used up 18 tons of industrial raw materials and foods per person per year—or 100 pounds a day for every man, woman or child.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Associate Editor

BRIEFING THE RECORD



Almost 4 million fuel pellets, assembled in rods and then in bundles, provide Dresden's power. **Heavy line** follows the sequence from fuel loading to the generation of steam, then electricity.

Dresden Dedicated

ANOTHER nuclear success story was celebrated on Columbus Day with the public dedication of Commonwealth Edison's Dresden Nuclear Power Station about 50 miles southwest of Chicago at the junction of the Kankakee and Des Plaines rivers.

Dresden is the first full-scale privately financed nuclear power plant. Owned and operated by Commonwealth Edison Company, the station was cosponsored by Nuclear Power Group, Inc., which in addition to Commonwealth includes: American Electric Power Service Corporation, Bechtel Corporation, Central Illinois Power Company, Kansas City Power & Light Company, Pacific Gas and Electric Company, and Union Electric Company.

Commonwealth paid $30 million of the $45-million contract price and also $6 million of site and overhead costs. The Nuclear Power Group paid the remaining $15 million as a research and development expense.

Ralph Cordiner, chairman of the board, General Electric Company, summarized the significance of Dresden by stating that it was "produced on a budget, ahead of schedule, and is even better than we had promised." The plant was scheduled for dedication December 8, 1960, but has been in operation since August 1.

General Electric, he said, made a major policy decision and a major investment in deciding to undertake a turnkey-type "firm customer contract to build the largest and most efficient nuclear power plant then conceivable."

There were a great many major critical problems to be solved in undertaking this "interlocking package of inventions." Major development was needed in heat transfer, fuel development, materials corrosion, nuclear physics, coolant chemistry, reactor pressure vessels, control-rod drives, reactor refueling, and the reactor-control and instrumentation areas. Dresden has demonstrated that a major plant can be estimated and schedules met without fear of "pioneering problems."

Mr. Cordiner stated that: "At General Electric, we will remember the work of Frank McCune [Mem. ASME], who gave the project its executive leadership; Sam Untermeyer [Mem. ASME], who conceived the reactor system here at Dresden; the late Bruce Prentice [past-chairman ASME Nuclear Engineering Division] and his associates on the team that created the technical concept of the station; George White and his associates . . . and hundreds of other General Electric men and women. . ."

Dresden has equaled or exceeded performance expectations in all areas. Transient behavior has been essentially as predicted, turbine efficiency has proved to be better than expected with the relatively wet steam, auxiliary-power requirements have been less than anticipated, and stability in all modes of operation has been excellent. Load following is completely automatic from 55 to 100 per cent of full load. While boiling-water reactors of the natural-circulation type have had some hydraulic-instability problems, the forced-circulation type is immune to those troubles.

So much has been learned of boiling-water-reactor technology that, after several months of full-scale operation, license modifications are being asked. A license to operate until 1996 has been granted by the Atomic Energy Commission for present ratings. The present fuel and core pattern sustains about 189,000 net ekw. With core modifications, 200 emw net is a possibility.

On the basis of Dresden experience, GE is now prepared to quote on a dual-cycle 400-emw or a single-cycle 300-emw boiling-water reactor.

S. D. Bechtel, president of the Bechtel Corporation, termed Dresden "a milestone not only in nuclear progress but in the utility industry throughout the world."

Commonwealth Edison, which has $^2/_3$ of the population of Illinois in its service area, will soon base load the plant on its system, which includes 12 conventional stations, and will have a capability of 5.2 million kw.

While other speakers at the dedication emphasized the peaceful uses of nuclear energy, AEC Chairman John

A. McCone, speaking the day after Russian Premier Khrushchev's UN statement about producing missiles "like sausages," referred also to the military uses. Stating that "our nuclear superiority, now the cornerstone of our defense, could easily slip from our hand," he advocated a resumption of underground testing as an aid to further nuclear development.

Stating that "we have carefully persevered through the 15 years of patient and sincere negotiation with the Soviets for a sound, workable formula for control of nuclear and other arms," Mr. McCone termed nuclear armament "the strong shield behind which we can push ever forward in the development of peaceful uses of this great new force."

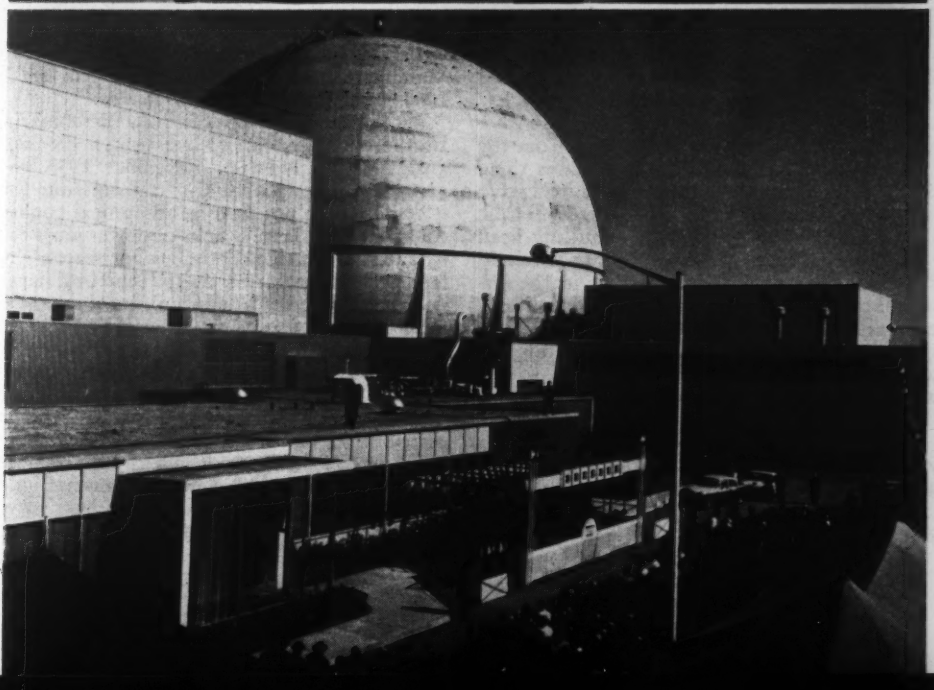
Others who spoke briefly at the dedication ceremonies were Governor William G. Stratton of Illinois; Congressman Melvin Price of Illinois, member of the Joint Committee on Atomic Energy; Gordon M. Freeman, international president, International Brotherhood of Electrical Workers; and Willis Gale, chairman of the board, Commonwealth Edison Company. J. Harris Ward, president of Commonwealth, was Emcee.

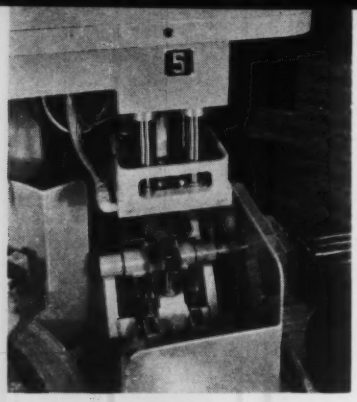
There have been some minor changes in the design since it was first described in MECHANICAL ENGINEERING (March, 1957, pp. 238–239). The reactor itself is an advanced dual-cycle version of Argonne National Laboratory single-cycle boiling-water reactor.

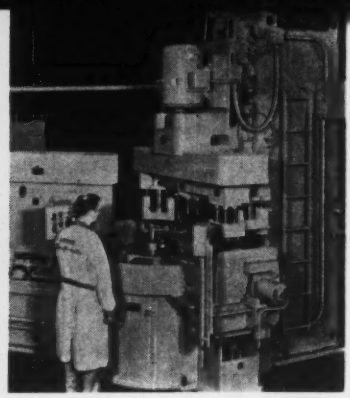
Water is boiled by fission heat inside the reactor core and produces steam at 545 F. The boiling water rises through large pipes to a huge steam drum where water and steam are separated. Primary steam is piped to the turbine generator at a pressure of 1000 psi.

The hot water separated from the steam flows down through four secondary steam generators which produce additional steam at 500 psi. This secondary steam flows to the turbine for admission at a lower stage.

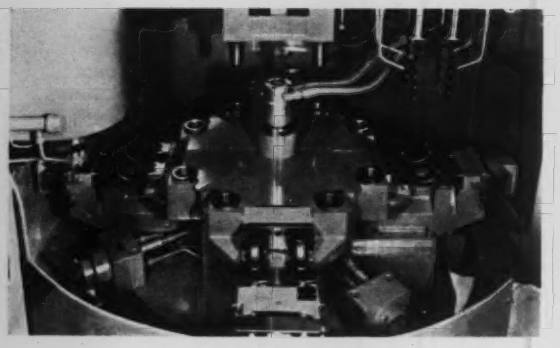
Ralph Cordiner, G-E Board Chairman, installs golden switch at Dresden, flanked by AEC Chairman John A. McCone and Commonwealth Edison Chairman Willis Gale. The Nuclear Power Group, cosponsor of Dresden, is represented by the company presidents behind the console, **left to right:** N. R. Sutherland, Pacific Gas and Electric Company; Allen Van Wyck, Illinois Power Company; J. W. McAfee, Union Electric Company; Robert A. Olson, Kansas City Power and Light Company; E. D. Edwards, Mem. ASME, Central Illinois Light Company; Philip Sporn, Hon. Mem. ASME, American Electric Power Service Corporation; S. D. Bechtel, Bechtel Corporation. The dedication ceremony is shown in the **bottom photo.**







Four-station dial machine, **far right photo,** has a fifth station off the dial, **near right photo,** where two spot-facing operations are completed on a part. Milling of the flats, drilling of holes to half depth, and drilling to full depth are completed on the dial, **below.** The milling cutter feeds across the joint faces from the left, while all other tools feed down. The fixture moving into the unload station is automatically clamped during table index.



Flexible Dial Machine

An unusual four-station dial machine, recently developed by the Cross Company, Detroit, Mich., has a fifth station off the dial. Unconventional location of the operations performed in this station has resulted in a smaller machine with fewer fixtures. The operator has more time to load and unload fixtures; cost of the machine is reduced; and the production rate is about 262 parts per hr at 80 per cent efficiency.

This machine was designed for flexibility and at the present time two different sizes of rear-axle carrier bearing caps are processed on it. Operations on the dial include milling of the flats, drilling of holes to half depth, and drilling to full depth. Caps are turned over as they are loaded in the fixture of the off-dial station and each of the holes in the cap is spot-faced.

The milling cutter is carried on a standard horizontal hydraulic-feed unit, and all of the rest of the tools, including the spot facers in the off-dial station, are carried in a special head mounted on a standard vertical hydraulic-feed unit.

In operation, the operator unloads two caps from the unclamped fixture in the load position and places them on a shelf adjacent to the off-dial station. He loads two raw parts in the dial fixture, actuates the hydraulic clamp, and then initiates the dial-index and milling-head cycles. During the dial index, he loads the two partially finished parts from the shelf into the fixture in the off-dial station, and presses a push button that hydraulically clamps these parts and starts the cycle of the vertical head. During the index, the dial fixture moving into the load-unload station is automatically unclamped so the operator can remove the semifinished parts and load two of the raw malleable-iron castings during the machining cycle.

As the vertical head retracts, it initiates a cycle that automatically unclamps the two parts in the off-dial station and activates the 360-deg rotation of a pair of arms in that station. These arms pick the parts out of the fixture and automatically transfer them to a discharge chute so the operator has nothing to do with unloading the finished caps.

As a safety feature, the fixture clamps on the main dial will be automatically actuated if the operator forgets to clamp the parts. This will eliminate the possibility that the milling cutters could lift the caps out of the fixture and throw them with considerable force.

This machine can be changed from the production of one size of bearing cap to the other in about $1^1/_2$ hr. The two parts are different as to height, hole size, and center distance of the holes. No change is required for the milling operation but the inboard hole locations have to be moved $^7/_{16}$ in. To achieve the two locations of the six movable spindles, eccentric spindle carriers are used. Each spindle carrier is unlocked, rotated 180 deg, and locked. Spacers and height blocks in the fixtures are changed to accommodate the new part size. Outboard location is kept constant so the clamp stroke does not have to be varied.

The final step in change-over is replacement of the drills and spot facers. Tool changing is simplified because all tools are preset in adaptors off the machine.

D-C Transmission for U. S.?

The shortage of cable duct space in streets in many metropolitan areas could well become the most important consideration in favor of cable transmission of power and may favor d-c, according to an article by W. E. Gutzwiller, Industrial Systems Department, Allis-Chalmers Manufacturing Company, appearing in the 2nd Quarter, 1960, *Allis-Chalmers Electrical Review*.

Recent European installations of submarine d-c cable-transmission systems (Mechanical Engineering, August, 1958, pp. 104–106; December, 1958, p. 75) have revived the question of d-c transmission for the U. S. "While we do not have geographical conditions in this country where large blocks of power must be transmitted by submarine cables," the author states, "we definitely face serious problems in transmitting large blocks of power to congested metropolitan areas. Because overhead transmission is not feasible, underground cables must be used."

Charging current alone would thermally overload a 345-kw a-c cable if its length exceeded 25 miles. With d-c, resistance rather than capacitance determines the distribution of dielectric stresses, and cable insulation can be stressed to three times the a-c rms voltage.

When it comes to overhead transmission, the econo-

mies with d-c are primarily in the better utilization of the line, resulting in a much lower line cost per kw transmitted. At present, terminal equipment for d-c is higher and less reliable than for a-c, and a point-to-point overhead d-c transmission line must be 400 to 500 miles long to overcome this. This may favor a few d-c long-distance system tie lines.

For a present-day d-c transmission installation, tubes of much greater rectifying and inverting capabilities are needed than are available. The latest foreign installations indicate that it should not be too difficult to design these tube ratings from available ratings. Should a market develop, such a design program could be carried out in a reasonable time and at a reasonable cost.

With the advent of the silicon semiconductor rectifier, new possibilities of simplifying the d-c terminal equipment and of reducing its costs are now in sight. By cascading silicon diodes of relatively medium voltage ratings, the high d-c voltages required for d-c transmission can be obtained.

Recent development of the controlled silicon rectifier, which is already commercially available in ratings of 100 amp and 500 peak inverse volts, means that this device may soon replace the mercury-arc inverter tubes at medium voltage. The possibility also exists that the high-voltage series stacks of silicon rectifiers may be physically built into the rectifier or inverter transformer, thus eliminating the secondary bushings and using a common cooling system for transformer and rectifier.

The controlled silicon inverter, because of its faster deionization time, should require smaller firing advance angles than mercury-arc tubes and hence less kilovars.

Iron-Ore Beneficiation

Successful operation of two Grate-Kiln systems at the Humboldt Mining Company has confirmed the feasibility of producing higher quality iron-ore pellets from low-grade ore deposits.

"This development of a high-iron-content ore from the vast low-grade reserves of the Lake Superior region, which is in strong demand by the steel industry, offers the prospects of economic rebirth for the area," according to a company official. "This is an attempt to answer the competition of rapidly increasing importation of high-quality, low-cost ores from overseas, which have made former standard-grade ores unsalable."

Located near Ishpeming, Mich., as a joint venture of Cleveland-Cliffs Iron Company and the Ford Motor Company, the Humboldt plant is the first installation of the Grate-Kiln system applied to iron-ore agglomeration. The pelletizing system used at Humboldt Mining was developed and manufactured by Allis-Chalmers to utilize process advantages of the traveling grate and rotary kiln.

Results have been favorable. Humboldt Mining reports reaching rated production of over 1000 long tons per day (ltpd) with a fuel consumption of approximately 1 million Btu per long ton. This compares favorably with the best results achieved elsewhere when processing magnetite.

Operations include a large open-pit ore reserve, a complete crushing/grinding circuit and beneficiation equipment, in addition to the pelletizing plant. Two parallel lines of Allis-Chalmers traveling-grate/rotary-kiln equipment are each rated 1000 long tons per day of pellets containing a rich 62 per cent total iron.

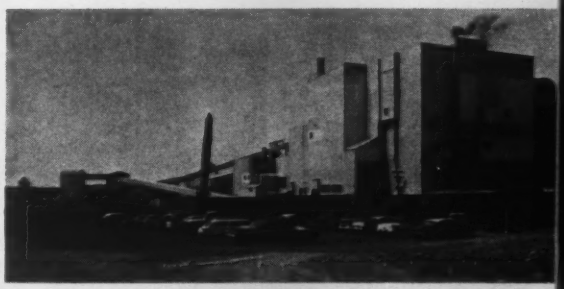
Production of specular hematite from Humboldt's open-pit mine and newly expanded concentrator is now 2000 ltpd of concentrates, beneficiated in operations employing a flotation technique. Following concentration to more than 60 per cent total-iron content, the hematite is balled in large-diameter, 30-ft-long balling drums. Balls are screened to permit only properly sized feed to enter the double-pass traveling chain and grate section.

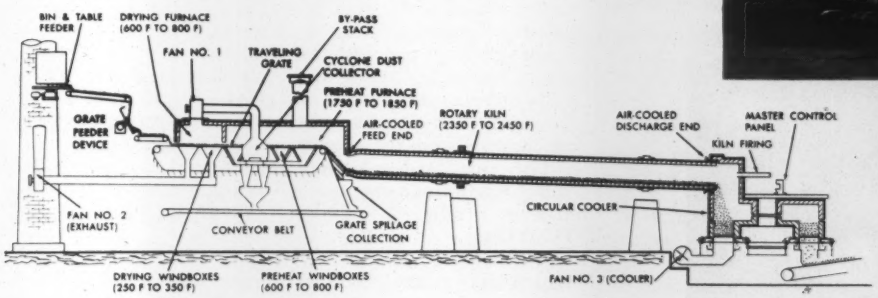
In the first or drying section, the green balls are subjected to a downdraft of approximately 600-F gases. This action dries the pellets and, at the same time, employs the moist pellet bed as dust collector for the process gases. The process gases are exhausted to atmosphere at about 250 F. Then, passing under a dividing baffle, the pellets enter the preheat section where high-temperature kiln exit gases are drawn through the bed to effect preheating and preliminary pellet hardening.

In order to achieve product uniformity and to accomplish the high-temperature processing in a machine best adapted to this phase, the pellets are then discharged from the traveling grate into a 120-ft-long rotary kiln where the final heat-treatment is approximately 2450 F.

The product from the kiln is discharged into an annular cooler, cooled by an updraft of ambient air, and delivered to the product belt (made of rubber). This cooling air recuperates the heat in the pellets, delivering it to the kiln as hot secondary air.

After cooling, the product is hard, dense, uniform pellet that is shipped by ore boat from nearby Marquette, then charged directly into blast furnaces

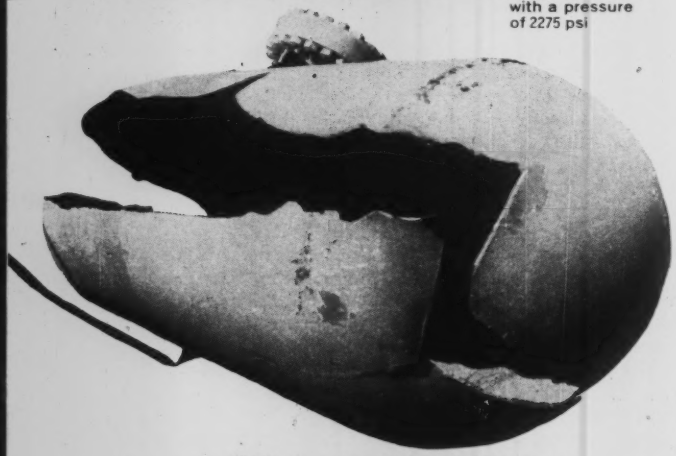




Iron-ore beneficiation operations center, above. A typical grate-kiln process for agglomeration and pelletizing is shown at left.

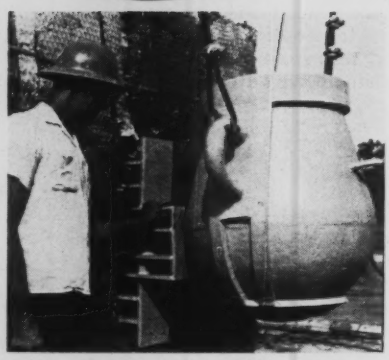
Left, the moment of burst in an internal-pressure destruction test of a cylindrical vessel fabricated from 9 per cent nickel steel and filled with liquid nitrogen

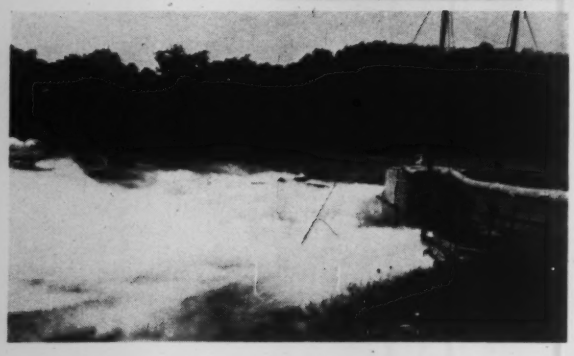
Below, the vessel ruptured at —304F with a pressure of 2275 psi



Right, an impact bar was used in some of the gravity pendulum impact drops with a 4340-lb wrecking ball

Below, liquid nitrogen at —320 F escapes from a rectangular pressure vessel fabricated from the 9 per cent nickel steel and designed for shipboard transportation of liquefied gas





"Operation Cryogenics"

MEMBERS of the ASME Boiler and Pressure Vessel Code Committees, and other Code and regulatory bodies, representatives of various government departments, and of industries concerned with the use, storage, and transportation of liquefied gases at temperatures as low as —320 F recently witnessed two days of tests at U. S. Steel Corporation's Fairless Works near Morrisville, Pa., on the Delaware River. The demonstrations were cosponsored by the International Nickel Company, Inc., and Chicago Bridge and Iron Company.

They were part of a series of full-scale performance tests of large vessels fabricated of 9 per cent Nickel Steel (ASTM A353-58 Grade B) in which they were impacted to failure or burst under pressure. The alloy developed in 1944 by Inco has been made available to the steel industry without licensing. Chicago Bridge and Iron did the fabrication and conducted the tests.

About 200 vessels for nonpressurized service, and hence outside Code regulation, have already been constructed particularly for liquefied-natural-gas service. The tests were made in preparation for an application to amend Paragraph UG-84, Section VIII, of the ASME Boiler and Pressure Vessel Code which requires stress-relieving after fabrication. It is claimed that superior properties for low-temperature service are obtained in unrelieved material and that this costly step can be eliminated.

Competition among stainless-steel, nickel-steel, and aluminum producers is keen for a large anticipated market for pressure vessels for storage and transportation of liquefied gases, particularly in the —150 to —320-F range. Not only are the steel producers themselves major users of tonnage oxygen (boiling point —297.3 F) in the new oxygen steelmaking processes, but suitable transportation methods will result in the salvage of billions of cubic feet of natural gas produced in oil fields and largely flared off where pipeline transportation is unavailable.

Considerable discussion has been reported about the possibility of moving liquid methane by ocean transport from Venezuelan, Algerian, and Middle Eastern oil fields to European cities and possibly to seaboard cities in the United States.

Nine vessels were built of the 9 Per Cent Nickel Steel for the tests. Three were rectangular to simulate shipboard-type containers for carrying liquefied gases. Six were cylindrical, simulating vessels used in land-based storage and transportation. All of the vessels were constructed of steel from the same heat, five in the quenched-and-tempered condition the remainder in the double-normalized-and-tempered condition. Six were as-welded and three were stress-relieved.

In the impact demonstration, the unrelieved quenched-and-tempered rectangular vessel filled with liquid nitrogen at temperatures near —320 F was still unfailed after seven gravity pendulum drops. In these, a 4340-lb steel "headache" ball was swung from heights of 11 to 19 ft representing kinetic energies of 47,740 to 82,460 ft lb. For four of the drops, internal pressures were ambient. Other pressures were 70, 85, and 43 psi.

The quenched-and-tempered unrelieved cylindrical vessel burst when the internal pressure reached 2160 psi at a temperature of —320 F, representing a burst stress of 132,000 psi.

All welding was done with Inco Weld A Electrodes which fall within ASME designation F45-E3N12.

Explosive Forming Used in Production

PRODUCTION parts of common metals are being explosively formed in high quantities by Rocketdyne, a division of North American Aviation, Inc.

Considered a significant new application of a process formerly directed toward difficult, high-strength materials, the production forming of common metals at costs competitive with other methods was described by the company at a meeting of the American Society for Metals. The company announced that its technical staff and extensive explosive-forming facilities, believed to be among the most complete in the nation, will be offered to other industries for the investigation of metal-working.

Rocketdyne began work in the explosive-forming field more than five years ago as an outgrowth of research by North American.

"We have demonstrated conclusively that the repetitive forming of common metals can be achieved at competitive costs," stated L. C. Stuckenbruck, supervisor of Rocketdyne explosive-forming activities. "Our thrust-chamber tubes, for example, are made from nickel and 20CB steel. We have used explosive forming to square the ends of more than 2000 tubes to close tolerances with negligible rejections and at a savings of about $10,000 over other processes.

"In many instances, explosive forming is the only method by which newer, more difficult parts can be formed," Dr. Stuckenbruck said. "One example of this is the turbine-manifold shroud that we are forming out of Rene 41 for the F-1 1,500,000-lb-thrust engine.

"Much of the saving that is possible with explosive forming is in the cost of dies. Stiffeners for a large bulkhead for the B-70 airplane were formed explosively with a single female die at a saving of almost $500,000 in tooling cost over that required to form the parts by drop hammer, using male and female dies.

"Speed is another important factor in considering explosive forming. For example, we were able to form a small thrust chamber for a rocket engine only 36 hours after it was decided to begin fabrication of a die."

Parts successfully formed by Rocketdyne range in size from small tube ends with a diameter of only 0.25 in. to large parts more than 5 ft in diam. The North American division also has conducted successful experiments in explosively flattening metal sheets that have warped during welding or heat-treat processes.

Parts have been successfully formed from high-strength metals such as Rene 41 and titanium as well as from common metals and plastics.

High-Temperature Machining

MACHINING some high-strength metals at high temperatures makes them easier to work, reduces tool pressure and cutting, and, in some cases, increases tool life up to 100 times, according to an Air Force research report on high-temperature machining tests released through the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce.

In addition to the test results, the report contains an evaluation of various heating methods including flame, furnace, induction, and radio-frequency resistance heating. Studies of heat distribution and flow within workpieces are described, and safety hazards discussed.

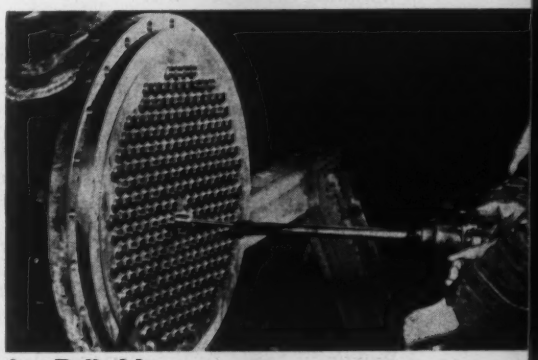
In face-milling tests of the hot-work die steel at 1000 F, tool life was increased 100 times. One of the precipitation-hardening stainless steels, subjected to the same tests, showed an increase in tool life of 20 times. Tool life increase in turning tests ran as high as 20 times for the low-alloy martensitic steel, and up to 5 times for a precipitation-hardening steel at temperatures up to 900 F. All increases were compared with average tool life for machining at room temperature.

Tests showed that, when welding occurs between chip and tool, a limiting temperature was reached at around 1100 F. Also, it was found that the angle between the point of cutter engagement and the workpiece as well as the presence of asbestos at the entry to the cut influenced tool life considerably.

No detectable changes in the microstructure of hot-machined specimens were apparent on examination, but microhardness checks showed that tempering occurred when the normal tempering temperatures were exceeded. The depth to which tempering occurred varied with the material and duration of heating.

No excessive safety or health hazards are reported, and ways of safely controlling heat sources are discussed.

Order PB 161680 from OTS, U. S. Department of Commerce, Washington 25, D. C., $3.



Impact wrench is used to roll Hastelloy B condenser tubes into tube sheets of a condenser. Rolling-in instead of welding eliminates the danger of corrosion in the heat-sensitized area around welded joints.

Condenser Tubes Rolled In

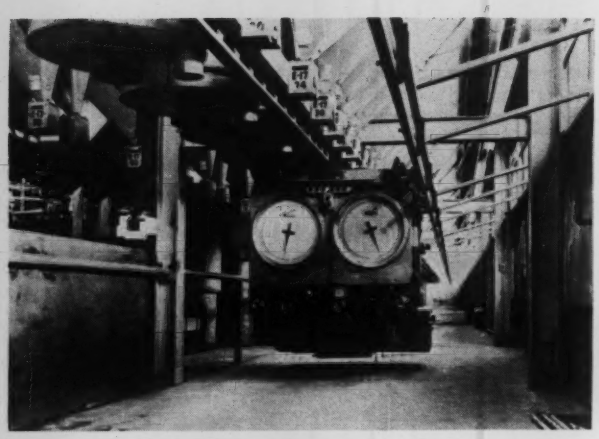
ROLLING condenser tubes into the tube sheet instead of welding them has eliminated heat-exchanger corrosion problems at a chemical plant producing a thermoplastic.

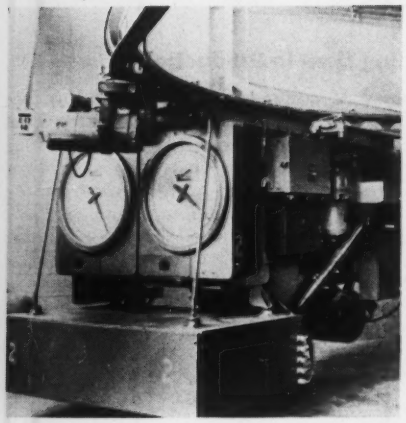
Two horizontal condensers with Hastelloy B heat-exchanger tubes rolled into the tube sheet have processed highly corrosive mixtures continuously for three years without developing leaks. Although the hard, tough Hastelloy B is difficult to cold work, the extra effort paid off by eliminating the corrosion-susceptible heat-sensitized area around welded joints.

Heat exchangers with welded tube sheets which processed the same type of fluids for the same length of time developed corrosion leaks on an average of twice a year. In addition to the maintenance expense involved in removing the tube bundle and repairing the leaking joints, each shutdown meant losing a half-day's production.

Each two-pass heat exchanger measures 30 in. in diam by 21 ft long and is made up of 250 Hastelloy B tubes. The tubes, made by the Carpenter Steel Company's Alloy Tube Division in Union, N. J., are 16 gage by $^3/_4$ in. OD by 16 in. long. The tube sheets are also Hastelloy B. Both condenser shell and baffles are carbon steel.

Mixtures are cooled 20 C (from 80 to 60 C) in the exchanger, then recirculated into the chemical process. Inhibited cooling water on the shell side enters at 30 C and leaves at 50 C.





Automatic-weighing equipment under punch-card control selects ingredients and delivers them to the mixing station. Three weighing carriages, suspended on a monorail, travel at 325 fpm in a loop in one direction only. Cycle starts, **right photo,** when the carriage approaches the card dispense to obtain its instructions.

Automatic Weighing System

COMPLETELY automatic weighing equipment is used in the Norton Company's new Plant 8 for the critical mixing of abrasive grain and bonding materials. The ratio of abrasive to bond determines the grade or "hardness" of the grinding action and is seriously affected by any errors in weighing the ingredients.

Three weighing carriages are suspended by a monorail which travels under a row of tanks containing the various sizes and types of abrasive grain and bonding materials. The carriages travel in a loop in one direction only.

They operate under IBM punched-card control, drawing correct amounts from the proper tanks and finally discharging at the correct mixing stations.

The mixing foreman plans his operations, usually the day ahead, by sorting his cards in the proper order to keep his mixer operators busy at a steady pace.

The cycle starts at the card dispenser which holds enough cards to keep the three weighing carriages busy for the 8-hr shift. The cards are issued one at a time to the receivers on the carriages which then travel at top speed of 325 fpm down the monorail.

Proximity heads on the carriage superstructure count off the tank markers and slow the carriage in time to stop at the correct tank. Air and magnetic brakes stop the carriage in correct position with the overhead-tank discharge gate. A mechanism on the carriage engages the gate and opens it, allowing the ingredients to fall into the hopper. As the correct weight is approached, the gate is throttled and the last few ounces are fed in slowly to insure accurate weight.

The brakes are of the normally closed type so any failure of the air system would cause the device to stop immediately. The air brakes are primarily to stop the large mass, and the magnetic brakes are used in inching the carriage into the final correct position for drawing, discharging, or picking up a new card. The air cylinder is replenished automatically with each new card.

When the total weight of abrasive grain and bond has been drawn into the hopper, the carriage moves around the loop to the discharging area. An elevator lifts a section of monorail to the high level and the carriage travels along to the designated mixing station. The short section of monorail in the carriage (at right angles to the direction of travel) which holds the batch hopper tilts and the individual hopper rolls out of the carriage onto a spur track over the mixing station. Then the carriage advances a few feet to another spur rail where an empty hopper is waiting for the next cycle. This also rolls by gravity into the carriage.

If an empty hopper is not ready at this station, the mixer operator pushes a reset button which advances the carriage to the next pickup station. If he fails to punch the reset button, a warning siren sounds.

The carriage continues to a second elevator which lowers the carriage to the lower level whereupon, it continues around the loop to the starting point.

The card which actuates the carriage is automatically delivered to the operator who uses it for additional instructions. When he has completed the mixing operation, the punched card then becomes his piecework coupon by which he is paid for his work.

The use of the card as a piecework coupon insures that it will be carefully handled. After the card is returned to the office, it is used by the accounting department for drawing off many items of useful information such as usage of abrasive grain, bond, and machine production.

Because three carriages operate on the same monorail, provision had to be made to prevent collisions. Lights mounted at each end of each carriage are part of an electric-eye control system which keeps the carriages at a safe distance from each other.

The system was tailor-made for the Norton plant by the Heltzel Steel Iron and Form Company of Warren, Ohio. Norton engineers worked closely with the Heltzel engineers in designing this equipment. Adaptations of gates and hoppers used successfully in other abrasive-handling operations were incorporated in the design.

The system was installed on the basis of improved quality of product. The accuracy inherent in the automatic weighing system is much greater than that which can be expected in manual weighing.

Breed Plant Dedicated

INDIANA and Michigan Electric Company's new and ultramodern $71.5-million Breed Plant on the Wabash River just west of Sullivan, Ind., was dedicated recently. It houses a single 475,000-kw steam turbine-generator with a capacity 40 per cent greater than that of the next largest generating unit.

The unit has already demonstrated a capability of 480,000 kw, some minor engineering changes would raise its capability to 500,000 kw. Design calculations and expectations based on the plant's operation since July 31 indicate that it will have a heat rate of close to 8530 Btu per kwhr, the most efficient yet. Until Breed, no plant in history had ever operated with a heat rate below 9000 Btu per kwhr.

Eastern Research Center of the Robertshaw-Fulton Controls Company was recently opened at King of Prussia, Pa. The center is divided into Mechanical, Electronics, Physics and Chemistry, and Gas Devices laboratories and is equipped with a miniature machine shop.

Eastern Research Center

ROBERTSHAW-FULTON CONTROLS COMPANY, a manufacturer of automatic temperature and pressure-control devices, instrument systems, and electrical switches and relays, recently opened its new 18,000-sq-ft $600,000 Eastern Research Center at King of Prussia, Pa. The company which comprises eight domestic divisions also has a Western Research Center at Anaheim, Calif.

The center designed and built by Day & Zimmerman of Philadelphia will be used for research in the range from basic to initial application with product development assigned to other company laboratories. Located on a 20-acre site in Upper Merion Township on the Schuylkill Expressway it is divided into Mechanical, Electronics, Physics and Chemistry, and Gas Devices laboratories, with a large miniaturized machine shop for model development.

Although much of the work being undertaken was not disclosed for proprietary reasons, two projects were shown that are of interest to mechanical engineers. A free-piston compressor, acquired from Battelle Memorial Institute (see MECHANICAL ENGINEERING, December, 1959, pp. 57-60) is being developed for gas-fired air-conditioning. The natural-gas industry is particularly interested because it would be a summer-load builder at a time when electrical systems are operating at peak and gas use is low.

Basic analysis of combustion, ignition, mechanical, and other problems is being undertaken with analog-computer simulation and test studies.

The sophistication of pneumatic controls is another important project. Largely overlooked in the furor over electronic controls, pneumatics have many advantages particularly in areas where an electric current or spark can introduce a safety hazard, or where pneumatic power can be important for servo functions. The company's Fulton-Sylphon Division already has a completely pneumatic control system for internal-combustion engines (see MECHANICAL ENGINEERING, July, 1960, p. 55), but there are many other places where pneumatic controls could be used.

Analogous pneumatic components are being perfected to replace the better-known electronic units. These will be as accurately rated and coded as their electronic equivalents. There is even provision for interlocking circuitry with a device that sounds a pneumatic whistle when a wrong or dangerous sequence has been followed. Remote telemetry can be accomplished with a "translator" or conversion unit that converts pneumatic pressure signals to electronic equivalents.

The World of Tomorrow

● **By 1970** London and Paris will be within two hours of New York by 120-passenger transatlantic airlines moving at three times the speed of sound, according to Alexander Kartveli, vice-president of research and development for Republic Aviation Corporation. This, he termed "only an intermediate step" to the "ultimate aircraft" capable of flying at 150,000-ft altitudes at 10 to 12 times the speed of sound—or about 7000 mph.

● **"Someday"** it will be possible to pick up your telephone and dial anybody in the world who has a telephone. American Telephone and Telegraph Company has begun to convert telephones to the all-number calling system, eliminating the 3-digit zone number and 2-letter and 5-number system now common in favor of a 10-pull all-number dial system to make world-wide dialing possible. C. M. Conway of AT & T disclosed the plans at a symposium on communication-switching systems at AIEE's Fall General Meeting.

● **Within a year,** AT & T's long lines department plans to put the first station of a solar-powered satellite-relay system into orbit at an altitude of about 2200 miles for experimental transmission of telephone calls, television, data transmission, and other types of communication between the U. S., the U. K., and continental Europe. If approved by the Federal Communications System, commercial service will follow.

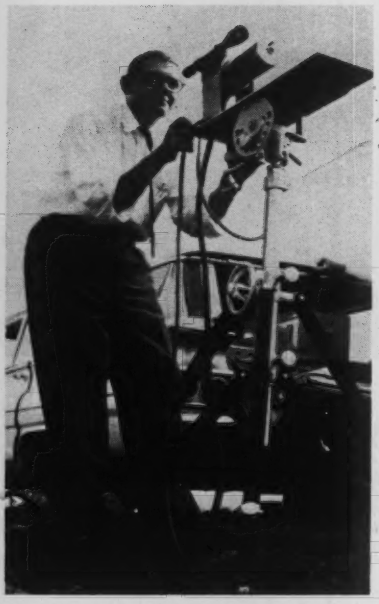
Eliminating the Butt-In

A SPEAKERPHONE system with "built-in" politeness circuits has been developed to connect large conference rooms with persons at distant locations by telephone.

The politeness circuits prevent interruption of those using the microphone at the conference table, either by parties having telephone connections with the system, or by persons in the conference room but distant from the microphone. The system was described in a paper by Luther R. Huggler of the Bell Telephone Company of Pennsylvania, at the Fall General Meeting of the American Institute of Electrical Engineers.

"Transmit lock out" and "receive lock out" are deliberately designed into the system. An enforced politeness is necessary to await pauses in other person's speech before attempting to break in.

The system may be frustrating to those using it for the first time, but most people quickly adapt to this situation and obtain a high degree of satisfaction from their use of this system, Mr. Huggler stated.



An optical maser at Holmdel, N. J., was flashed toward Murray Hill, N. J.

Contact was maintained by telephone between two Bell Telephone Laboratories locations. Maser flashes 25 miles away were received on a phototube.

Communication by Piped Light

WITHIN a decade, the ASME Petroleum Division—since it has the most experience with pipelines—may be called upon to design a pipeline for light beams. Just in case you think someone has taken leave of his senses, hold on awhile!

With radio, television, wire, and other communication circuits crowded, Bell Telephone Laboratories, Inc., is in the basic-research stage on the development of an optical communication system. The prize for its development is the possibility of carrying as many as 10,000,000 simultaneous TV channels on a single 1-Å-wide bandwidth, whereas in the microwave region a single bandwidth cannot even carry a telephone conversation. Basic to its success is the optical maser, on which Hughes Aircraft Company's research laboratories recently disclosed their work (MECHANICAL ENGINEERING, September, 1960, p. 75). Bell Laboratories, C. H. Townes of Columbia University, and a number of others have also been working on the optical maser.

Since most of the technology and terminology are new, explanation is not a simple matter.

Stimulated emission of electromagnetic radiation is the key concept. The maser achieved this for radio waves. The optical maser does it for "light" waves—the infrared, visible, or ultraviolet portions of the spectrum. With the optical maser, light waves are "optically pumped" or amplified to an intensity a million times brighter than the sun, yet with a cone so narrow (of the order of $^1/_{20}$ of a deg) that the beam, if it were directed at the earth from a satellite, would be only a few hundred feet wide.

Piping will be required to use the light beams for communication between points on the earth, because the dust and fog of the atmosphere would attenuate the light beam. Although infrared has greater atmosphere penetrating power than ordinary white light, it cannot penetrate rain or heavy fog.

One of the subphenomena connected with the interference of light waves is their ability to reinforce each other under certain circumstances. To use the analogy of ocean waves, when the peaks of two separate waves coincide they combine to produce a wave of greater amplitude. In light this phenomenon is known as optical pumping.

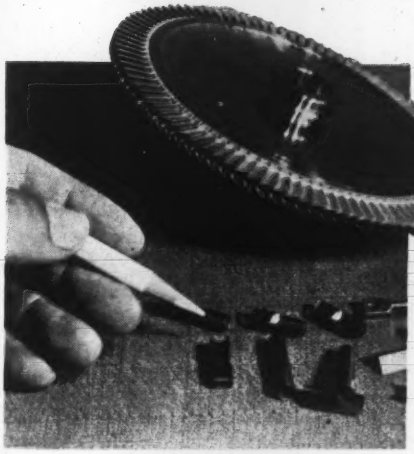
By "injecting" a beam of light of a desired frequency into a population of atoms of various energy levels, the atoms can be stimulated to emit amplified light of the desired frequency. This is a sort of chain reaction in which the reaction accelerates rapidly and the active population of atoms is quickly depleted. This results in a pulsed alternate depletion and restoration of the active population of atoms. Each burst is less than a millionth of a second long, and the bursts are spaced only a few millionths of a second apart.

The maser itself is a chamber having reflective end parallel plates and side walls. Constructed of a synthetic-ruby rod $1^1/_2$ in. long and $^1/_5$ in. in diam, the two ends were polished until extremely flat and parallel, then covered with a reflecting layer of silver thin enough to be slightly transparent. The ruby rod is surrounded by a spiral photoflash lamp. The side walls of the rod are transparent to the pumping energy and either transparent to or absorptive of other energy radiated at them.

Only the light which makes many passes back and forth through the ruby rod stays in it long enough to accomplish much stimulation. On each trip additional energy is gained and only those waves traveling along the axis are built up. Since the end plates are small in comparison with the distance separating them, only the waves traveling along the axis are amplified. What emerges is 60 times closer to being "monochromatic"—of a single frequency—than the ordinary fluorescent light from ruby. It is "coherent"—of a single phase—and has high directionality—that is, there is very little spreading.

Ruby is the material that has been used to date, but any number of materials have potential use in masers. For example, vapors of the alkali metals; namely, lithium, sodium, potassium, rubidium and cesium, and some solid rare-earth salts may be used.

In addition to the potential for communications, coherent light may make it possible to measure long distances with the millionth-of-an-inch accuracy now possible only in laboratories. It will make possible spectroscopy at very much higher resolution. It will also have chemical process potential.



Sheet-metal turbine buckets cut the weight and cost of small turbine wheels by more than 50 per cent. Low inertia also simplifies control problems.

Sheet-Metal Turbine Buckets

THE successful development of sheet-metal turbine buckets that cut costs and weight of small turbine wheels by more than 50 per cent has been announced by the General Electric Company.

Climaxing three years of intensive development effort, the units represent a "significant advance in the state of the art of turbine-bucket design," according to W. C. O'Connell, department general manager.

Their first application is in two new highly advanced turbine-powered fuel pumps for use in GE's J93-3 jet engine, scheduled to power the North American B-70 Mach 3 intercontinental bomber.

The use of high-temperature nickel-base alloy sheet metal in the pump's two-stage turbine wheel and nozzle results in weight savings of more than 2 lb in the 18-lb unit. In addition to being lighter in weight than conventional cast-and-machined buckets, the sheet-metal buckets permit further weight savings in the design of the turbine wheel and protective shroud. The low inertia of the lightweight rotor, in turn, can simplify control mechanization, thus further reducing weight and cost.

According to E. K. Bullock, project engineer, the reliability of the new units, based on test results, meets or exceeds that of conventional small cast-turbine-wheel design. The units are scheduled to undergo extensive engine-performance testing shortly.

The lightweight turbine wheel is designed to operate in air temperatures above 1000 F for up to 1000 hr without maintenance. The sheet-metal buckets should find a wide variety of turbine applications. Additional development will be necessary, however, where significantly higher temperatures are encountered and where twist and taper bucket designs are required.

While buckets are welded to the wheel in the AF12-3 fuel-pump application, other conventional methods of attachment such as pinning or brazing are also practical where necessary to meet varying operating conditions, Mr. Bullock said.

Generator Installation Begins at Niagara

THE Westinghouse Electric Corporation has begun installation of the first of 13 huge water-wheel generators at the Niagara Generating Plant of the $720-million Niagara Power Project. The project is being built by the New York State Power Authority, whose chairman is Robert Moses.

A. C. Monteith, Hon. Mem. ASME, Westinghouse vice-president, apparatus products, said the units are rated at 150,000 kw each, and are the most powerful water-wheel generators ever built by an American manufacturer.

Each generator weighs 1115 tons and the combined output of the 13 generators will be 1,950,000 kw.

With an additional 240,000 kw from the nearby Reservoir Pump-Generating Plant, the Niagara Project will have a total installed capacity of 2,190,000 kw, surpassing Grand Coulee's 1,974,000-kw—presently the largest hydroelectric-power source in the western world. Westinghouse also made the 18 108,000-kw generators now in operation at Grand Coulee.

The outer edge of the rotor in each generator at the Niagara Power Project will rotate at 120 rpm. Each generator is 40 ft in diam. Its rotor spins on a 50-ton shaft that is 50 in. in diam.

The Westinghouse generators will produce power at 13,800 volts. Transformers will step this up to 115,000; 230,000; or 340,000 volts depending on transmission requirements.

The project is being built on an accelerated schedule because of a major power shortage in the area, caused primarily by a rockslide near the Falls in June, 1956, that destroyed a major portion of the Schoellkopf power station.

First power is scheduled to be produced less than three years from the start of construction.

The Niagara Generating Plant is located three miles below Niagara Falls. It has been built into the Niagara Gorge wall, from which more than 7,000,000 cu yd of excavation, mostly rock, were gouged out to accommodate the plant.

Water for the plant is taken from the Niagara River some $2\frac{1}{2}$ miles above the Falls. It flows through two 46-ft-wide by 66-ft-high underground concrete tunnels for four miles and empties into an open canal which leads to the Niagara Generating Plant.

At the generating plant, the water enters 13 penstocks, which are 24 ft in diam and 462 ft long to the bottom of the plant. The actual water drop, or operating head for the plant is an average 305 ft.

A treaty between the United States and Canada limits the amount of Niagara River water that can be used for power and provides a water flow over the Falls of a least 100,000 cu ft per sec during daylight hours in the tourist season—sufficient to maintain the beauty of the Falls.

Large Power Units Cheaper

ACCORDING to system-simulation tests by a digital computer, large power units are more economical in the long run, it was revealed at the Fall General Meeting of the American Institute of Electrical Engineers.

In estimating cost structures for the Public Service and Gas Company, it was found that "patterns with ultimate sizes of about 1000 mw, about 10 per cent of the Public Service system, were optimum for assumed interconnection policies," and also that "single-boiler units are more economical than units with twin boilers."

The findings were reported in a paper delivered by C. J. Baldwin and C. A. DeSalvo, Westinghouse Electric Corporation, East Pittsburgh, Pa., and H. D. Limmer, of the Public Service Electric and Gas Company, Newark, N. J.

Nuclear-Superheated BONUS Reactor

NUCLEAR superheat, with its expected dividend of about 10 per cent reduction in the potential cost of power from boiling-water reactors, is currently planned for two reactors, Pathfinder and BONUS.

BONUS (Boiling Nuclear Superheater Power Station) is to be built near Rincón, Puerto Rico. General Nuclear Engineering Corporation developed the preliminary design under subcontract to the Puerto Rico Water Resources Authority. The Water Resources Authority will build the plant jointly with the U. S. Atomic Energy Commission.

As described in the September, 1960, issue of *Power Reactor Technology*, prepared for the U. S. AEC by General Nuclear Engineering Corporation, BONUS will have a net electrical output of 15,000 kw. The core of the reactor consists of two distinct zones: (*a*) A central forced-circulation boiler region which produces saturated steam at 900 psig and 534 F, and (*b*) a peripheral four-pass steam-cooled region which superheats the steam to 900 F. The steam passes directly to a conventional turbine which operates at throttle conditions of 850 psig and 900 F. Total heat output is 50 mw; the gross electric output of the generator is 17,300 kw, giving a gross efficiency of 34.6 per cent.

The forced-circulation boiler zone consists of 64 square fuel assemblies on a 4.36-in-sq lattice containing 2.81 tons of uranium element. The superheater zone consists of 32 fuel assemblies arranged in four groups of eight assemblies around the square boiler zone and contains 1.79 tons of uranium element. Each superheater assembly contains 32 fuel elements mechanically arranged to yield eight parallel paths and four series passes for the steam.

Each fuel element is a stainless-steel-clad, UO_2 (3.5 per cent U-235) pellet, rod-type element. The fuel rod is surrounded by a stainless-steel tube to form the steam coolant annulus, and this, in turn, is surrounded by a stainless-steel pressure tube which provides a thermal insulating gap between the coolant tube and the surrounding water moderator. The superheater core is divided into eight zones, each of which can be monitored for exit temperature, flow, and fuel-element failure. An average specific power of 7.25 tmw per ton of uranium, a core power density of 12 tkw per liter of core, and a coolant power density of 83 tkw per liter of coolant are obtained.

Maintaining a constant steam outlet temperature, irrespective of changes in over-all reactor heat output required to accommodate variations in electric load, is one of the major problems in designing an integral boiler-superheater reactor. Reductions in over-all heat output can be readily accomplished by inserting control rods, but it is difficult to do this without distorting the ratio of the heat output of the boiler to the heat output of the superheater. Control-rod insertion in the boiler zone must be paralleled in the superheater by amounts such that the power ratio, as indicated by steam outlet temperature, remains constant. Since perfection is not expected in this manipulation of control rods, the steam outlet temperature of BONUS will be allowed to vary slightly, as necessary, within the range 900 to 950 F. The temperature will be reduced to 900 F before the steam reaches the turbine by controlled injection of the required amount of feedwater into the steam in an external attemperator.

"Annihilation Reaction"

"ANNIHILATION REACTION," a proposed type of nuclear energy, one day will power interplanetary ships.

The fuel of the future will be created by the collision of electrons and positrons in the atom, John J. Grebe, Mem. ASME, director of nuclear and basic research for the Dow Chemical Company, Midlands, Mich., told a power generation symposium at the Fall General Meeting of the American Institute of Electrical Engineers in Chicago, Ill.

The annihilation reaction, which he said is misnamed, "happens when an electron and a positron attract and fall into each other," thereby generating an "infinite amount" of energy. "The attractive force between a plus and a minus charge approaches infinity as the distance apart decreases to zero, and of course, a near infinite amount of force acting at even a short distance produces a lot of foot pounds."

Mr. Grebe who is a member of the ASME Technical Development Committee, said "there is no reason why we should not harness the annihilation energy and binding energy and put it to work for us. This I feel confident will be done by large electromagnetic fields increasing the chance of electron-positron interactions adjacent to space vehicles, so that we can capture this energy and convert it into thrust."

Fantastic as it seems, there is more known about these interactions than was known about fission at the beginning of the Manhattan Project, he said.

"Hundreds of accelerators are duplicating in the laboratories what nature does in space. Hundreds of targets are under study every day. With the very light inflated conductors capable of converting areas enormous compared to laboratory target areas, results may be achieved that will astonish us."

While we are still looking "for a fundamentally sound approach to the industrial application of nuclear power" which may be 10 to 50 years away, there have been developments in the peaceful use of atomic energy, which Mr. Grebe characterized as "the cleanest and safest form of energy that man has yet learned to control."

Nuclear hazards "are so easy to spot with modern equipment—and so easy to avoid compared to many other hazards to which man is exposed—that one of our great challenges of the sixties may be to bring about a broader understanding of the safety and cleanliness of this form of energy."

Mr. Grebe urged a broader philosophy in thinking about the use of nuclear energy and said that low-grade fossil deposits could be set afire by atomic bombs, then kept afire, with steam for huge electric generating plants being utilized from the bombed mine. He also pointed out that it is possible to use atomic energy to convert minerals while they are still in the ground to other chemical products.

Speaking of the recovery of sulfur and smoke-producing hydrocarbons "now smogging up the cities," he said, "I think I have an H_2S and volatile-hydrocarbon process for doing this profitably on a big scale, particularly at the points where coal is trans-shipped or used in large quantities. Where good coal is available, and by-products of its carbonization pay for the process, it has the possible goal of lower fuel consumption and lower investment charges. But in the long range, 10 to 30 years, we will also solve the problem of using the lower-grade fuels.

New Plutonium-Production Reactor

Economic and design studies are under way for the New Production Reactor, NPR, for the production of plutonium, scheduled for completion by October, 1962. The reactor will be an improved version of the Hanford graphite-moderated water-cooled reactor and is being designed by the General Electric Company, Hanford, Wash. Estimated to cost $145 million it will have sufficiently high coolant temperatures and pressures to produce secondary steam, and facilities are to be included in the reactor to provide for conversion, at some future date, to either dual-purpose (plutonium plus power) operation or power-only operation.

According to the September, 1960, issue of *Power Reactor Technology*, prepared for the U. S. Atomic Energy Commission by General Nuclear Engineering Corporation, preliminary construction of the reactor is under way, and initially the secondary steam energy will be dumped, through an exchanger to the Columbia River.

A large graphite-moderated reactor, the NPR is cooled by light water passing through 1004 Zircaloy-2 process tubes which house the fuel. This is slightly enriched uranium metal clad in zirconium. After the coolant passes through the reactor, it is split into five parallel loops, each of which contains two heat exchangers. It is the 87-psia steam generated in these secondary heat exchangers that would be condensed by the river, although for power operation it would be used to drive a turbine. Steam pressure could be increased by changing from five to seven coolant loops and/or operating the reactor at reduced power to permit an increase in the primary-coolant temperature.

Although the final capacity selected has not been released for security reasons, a total of 24 different cases was studied, ranging from an electrical capacity of 388 to 848 emw without coal-fired superheat and to 1186 emw with coal-fired superheat.

If an 80 per cent plant factor could be realized during dual-purpose operation, energy costs would be 2 mills per kwhr. Actually, only 40 per cent will be realized because of the excess of hydroelectric power that will be available in the summer months for some years to come in the Pacific Northwest Pool.

Nuclear Briefs

▶ Molten-Salt Reactor Experiment at ORNL

The potential economic advantages for power generation of excellent steam conditions and higher efficiency through operation at very high temperatures and specific power are to be investigated with the Molten Salt Reactor Experiment, MSRE, scheduled for operation in 1963. The MSRE, to be built at Oak Ridge National Laboratory and being designed with some assistance by Burns and Roe, is a 10,000-tkw reactor although routine operation will be at about 5000 kw. No electrical power will be produced, heat being dissipated to the atmosphere through a secondary heat exchanger.

The MSRE is planned as a single-region reactor for operation at 1225 F. It will have a cylindrical graphite core about $4\frac{1}{2}$ ft in diam and $5\frac{1}{2}$ ft high. Columns of graphite will extend the full height of the core. The molten-salt fuel, a solution of fluorides of lithium 7, beryllium, uranium, zirconium, and thorium, will be pumped through some 600 channels in the graphite columns. The heat will be removed from the fuel solution in a primary heat exchanger that will use a mixture of lithium and beryllium fluorides as the coolant.

The reactor core will be housed in a pressure vessel made of Inor-8, which is a nickel-base alloy containing molybdenum and chromium. The alloy was developed under the Aircraft Nuclear Propulsion Program to provide a material that could withstand the high temperatures needed for operation with fluoride salts.

Molten-salt fuels were developed originally for use in reactors for nuclear aircraft and much of the research and development work earlier carried out by ORNL in connection with aircraft reactor systems is applicable to the MSRE work.

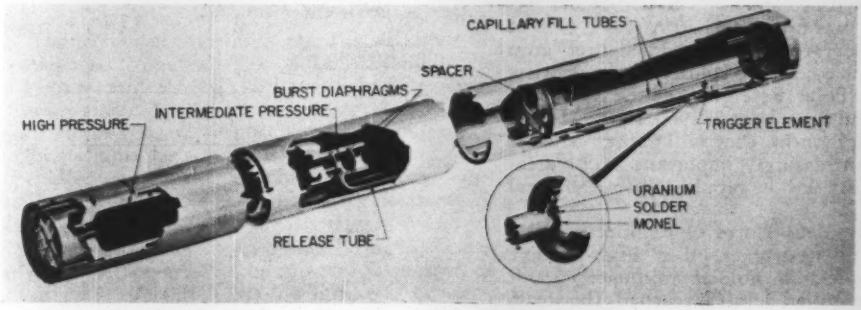
Cost of the experiment is estimated at about $4.1 million, exclusive of research and development.

▶ Nuclear-Reactor Safety Fuses

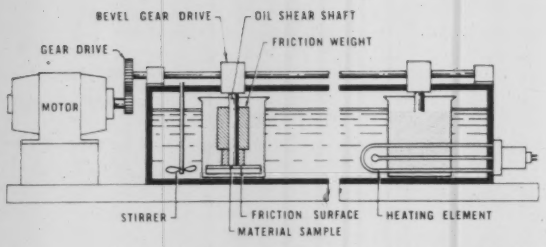
Nine nuclear-reactor safety fuses have been built by Atomics International, a division of North American Aviation, Inc., for the Atomic Energy Commission. The fuses will be used in the Maritime Gas-Cooled Reactor Critical Experiment, operated by the General Atomic Division of General Dynamics Corporation, at San Diego, Calif., under contract with the AEC.

Use of a fuse which will automatically shut down research reactors without the use of external controls is expected to provide additional protection in certain types of experimental reactors.

Completely self contained in a cylinder, the fuse is partly inserted in the core of a reactor where atomic fission takes place. The part outside the core contains boron-trifluoride gas. In an operational device the gas would be released automatically into the other part of the cylinder in the event of a power surge. The gas would absorb neutrons required to maintain the chain reaction, bringing the reactor under control almost instantly and without damage.



A safety fuse for nuclear research installations brings the reactor under control almost instantly and without damage



Basically, the Pemoot oil tester consists of six beakers inside a large glass-walled tank containing a heat-transfer liquid and a thermostatically controlled electric immersion heater

Oil Tester

A NEW system for testing the durability of lubricating oils for wick-fed journal bearings will enable designers and lubrication engineers to test up to six samples of oil simultaneously under laboratory conditions which are virtually indistinguishable from those encountered in actual bearing applications.

Named Pemoot (short for Permawick Electric-Motor Oil-Oxidation Tester), it was developed by the Permawick Company, of Detroit, Mich.

Pemoot produces under controlled conditions the four physical phenomena which cause degradation in lubricating oils: (*a*) Continual shearing of oil, (*b*) heat, (*c*) reaction on lubricant by ambient conditions, (*d*) chemical or catalytic effects of metal-wear debris.

Oil samples aged in the Pemoot are then tested by standard ASTM methods to measure three indexes of degradation: (*a*) Changes in oil viscosity, (*b*) increases in oil acidity, (*c*) formation of insolubles.

The Pemoot is of modular construction and may be used to test one or more oils at the same time. Basically it consists of six beakers inside a larger, glass-walled tank. The tank contains a heat-transfer liquid and a thermostatically controlled electric immersion heater. Extending into the beakers are powered shafts. Brackets which fit inside the beakers hold thrust plates of bearing metals, usually tin babbitt or sintered bronze. Weighted friction disks on the bottoms of the powered shafts rotate against the thrust plates.

In operation 500-cc samples of specimen oils are placed in the inner beakers, the heater is adjusted to the desired temperature, and the Pemoot, powered by an electric motor, is actuated. Rotation of the shaft creates a vortex, drawing controlled amounts of air down into the oil and into the friction area.

Drilling Wells With Steam

RAPID conversion of abundant quantities of ice and snow to usable water has been achieved by drilling water wells into glacial ice with steam.

The unique system was first tested in August, 1960 at Camp Century, an underground city huddled high atop the Greenland ice cap, where 200 soldiers and scientists of the U. S. Army's Polar Research and Development Laboratories will spend the winter of 1960–1961. There, through the long dark months, they will gather valuable data relative to the increasingly important Arctic area. The 200-man community will be supplied with 10,000 gal of fresh water daily.

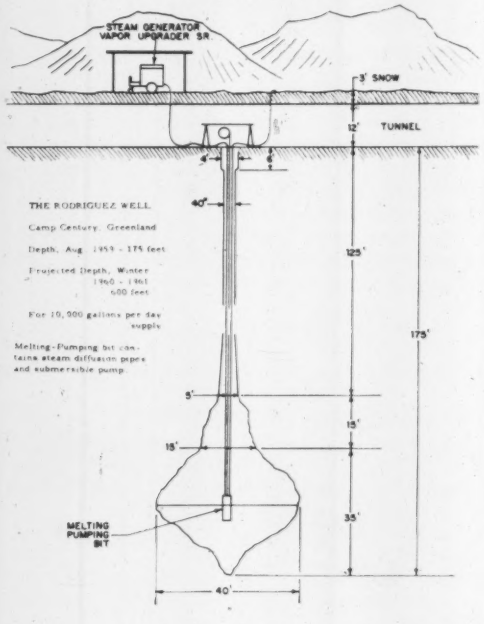
The system, developed by Corps of Engineers senior project engineer Raúl Rodríguez, uses high-pressure steam to melt a 3 to 4-ft-diam hole approximately 150 ft in depth. Once the required depth is reached, the steam is directed against the sides of the shaft until a bell-shaped reservoir up to 50 ft in diam is formed. The water thus accumulated is pumped into the camp's water supply as needed. As it is consumed, the water is replenished by drilling deeper into the ice cap.

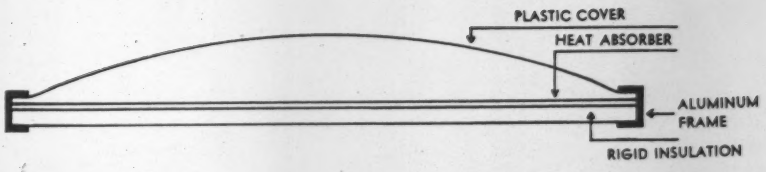
A highly efficient portable steam generator furnished by Vapor Heating Corporation of Chicago, Ill., is the key to the process. Originally designed to steam-clean heavy railroad equipment, the unit is capable of producing 1200 lb per hr of steam at a pressure of 100 to 175 psi. According to its manufacturer, its boiler-horsepower rating is sufficient to heat 15 average sized homes in subzero weather.

The high volume of steam production is achieved by utilizing almost 300 ft of boiler tubing coiled within a compact 6 × 3-ft frame. The inner coil, which is fabricated of 1-in-OD Babcock & Wilcox Lectrosonic carbon-steel boiler tubing, is 90.7 ft in length. The outer coil, of $^{3}/_{4}$-in-OD B&W ASTM A-178 Grade A Carbon Steel Lectrosonic tubing, measures 206.5 ft. The excellent heat-transfer properties of the uniform-wall electric-resistance-welded tubing facilitates the rapid conversion to superheated steam. The feedwater, entering through the outer coil, is washed by 2700-F exhaust gases. It is transformed from water to virtually dry steam as it passes through the 300 ft of conical-shaped coil.

One of the unexpected side benefits of the study to date has been the discovery that the steam-excavated reservoirs make ideal storehouses for all manner of items. Gasoline can be stored directly in the unlined ice reservoir without loss or impairment of quality. Tools and machinery can be left for long periods without damage or rust. The storerooms are ideal for keeping surplus crops without deterioration and could serve to hold excess foodstuffs on a long-term basis as an emergency food reserve.

Abundant quantities of fresh water for an arctic base are obtained by drilling water wells into glacial ice with steam





Fully assembled solar-energy absorbing panels with high thermal efficiency need only to be connected to serve as water heaters for a number of uses

Materials Briefs

▶Solar-Energy Flat-Plate Absorbing Panels

AN ABSORPTION plate designed for minimum reflection and maximum conduction to the coolant is being made by Solar Products Corporation, Opa Locka, Fla. The 18-sq-ft flat-plate absorber has a contoured plastic cover which refracts the rays of the sun for optimum performance at all daylight hours. Standard 3 × 6-ft panels weigh less than 40 lb and are shipped fully assembled with standard fittings. They can be arranged in batteries of any number of panels for use as thermal siphons or in forced systems. They will serve with high efficiency for such applications as domestic or industrial water heaters.

The panels will absorb and deliver more than 90 per cent of solar radiation received—for example, at 30 deg latitude, noon, August 1, with clear sky this equals 320 Btu per sq ft per hr. All metal parts are of copper, Alclad, or anodized aluminum. The insulation is entirely stable and impervious to water. The plastic cover will retain 98 per cent of its transmission ability after 10 years' exposure.

▶Epoxy-Resin Concrete Repairs

Adhesives and binders containing epoxy resins are being used by the California Division of Highways to repair concrete. Under favorable conditions, repairs have been opened to traffic within 3 to 5 hr.

The process is described in a paper, "Repair of Damaged Concrete With Epoxy Resins," presented by Bailey Tremper, supervising materials and research engineer for the Highway Division, at the 56th Annual Convention, New York, N. Y., March 14–17, 1960, of the American Concrete Institute.

A plasticizer and a curing agent—generally an amine—complete the formulation for either adhesive or binder use. Cost can be reduced by incorporating a certain amount of finely ground filler such as talc or silica.

The formulation most frequently used consists, by weight, of : Epoxy resin 10 parts, polysulfide polymer 4 parts, curing agent 1 part, and variable quantities of filler. The epoxy resin has an epoxide number of 175 to 205 and a viscosity at 25 C of 5 to 9 poises.

The polysulfide polymer is a difunctional mercaptan having a specific gravity, 20/20 C of 1.27 and a viscosity at 25 C of 7 to 12 poises. Two curing agents have been used. One is 2,4,6-tri(dimethylaminomethyl) phenol.

The other curing agent is dimethylaminomethylphenol. The first agent yields a pot life of about 20 min at a temperature of about 70 F, and the second on the order of 45 to 60 min at 70 F. Filler is a finely ground, pigment-grade silica.

Since pot life is relatively short, final combination of the ingredients must be accomplished at the site. For patching spalled areas with epoxy mortar, or epoxy concrete, little or no filler is used and pot life is about 20 min at 70 F.

After preparing the surface by sandblasting to insure the removal of oil or grease, the mixture is pressed or tamped into place and the exposed surface is brought to grade by screeding or troweling. Cost is about $200 per cu yd.

Only a few of the applications have been made in areas where the temperatures drop below zero, and it cannot yet be stated whether the formulation yields adequate flexibility under those conditions.

Epoxy adhesives and binders should not be confused with other compounds such as polyvinyl acetates, polyesters, neoprene emulsions, and styrene-butadiene copolymer dispersions in water. Such compounds, the author states, can function as adhesives, binders, or modifiers of portland-cement paste, and under certain conditions can develop strengths that are adequate for the work in hand. None, however, appears to possess fully the useful characteristics of properly formulated epoxy systems which include the ability to establish strong and permanent bonds to both fresh and hardened concrete, negligible volume change on curing, the retention of cured strength in the presence of water, and outstanding resistance to weather and chemical agents.

▶Metal-Bonded-Graphite Bearing Materials

New metal-bonded graphite materials that combine the strength of metals with the unique antifriction properties of graphite have been developed by the Ford Motor Company. They were shown at a recent seminar on powder metallurgy sponsored by the AIME at the 42nd National Metal Congress.

The graphite-rich compositions would be suitable for dry-bearing applications. They have shown strengths superior to the best strengths of pure-graphite materials and offer improved mechanical properties and close dimensional contro' of parts. They can be made by conventional high-volume powder-metallurgy production techniques.

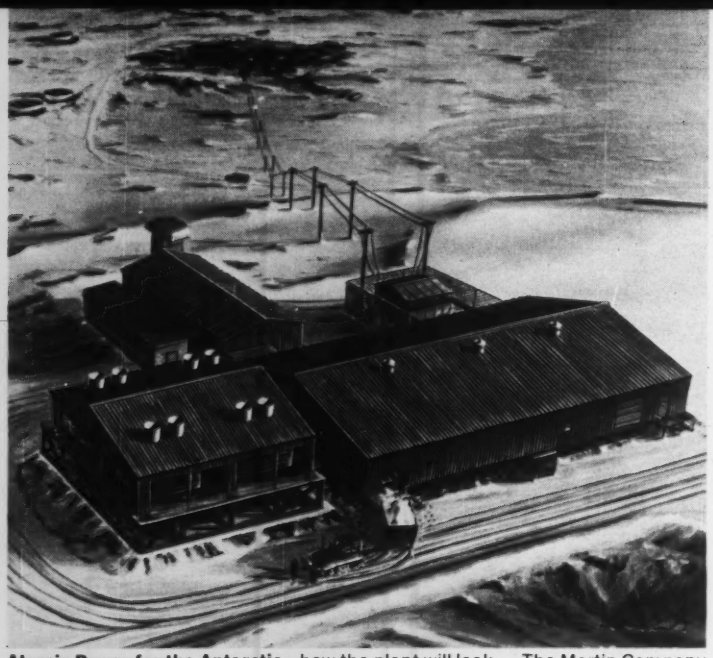
Strengths also compare favorably with the best obtained in porous-metal compositions used for externally lubricated bearing applications and have a much higher range of satisfactory performance.

The materials also are being considered for possible use in electrical and specialized high-temperature applications.

The powder constituents are mixed and cold pressed into "compact." These are heated to liquefy the metal (liquid-phase sintering). Previous attempts to combine graphite with iron in this manner, always resulted in products with poor strength and extremely brittle characteristics because of the poor compatibility of liquid metals and graphite.

In the new Ford process, the addition of a powdered calcium-silicon alloy during liquid-phase sintering produces a material combining the best properties of iron and graphite. Compositions have been prepared that range from 40 to 90 per cent graphite by volume.

In addition to the liquid-phase sintering of iron-graphite compositions, nickel, cobalt, copper, silver, and aluminum-graphite combinations have been made successfully by the process.



Atomic Power for the Antarctic—how the plant will look. The Martin Company is prefabricating the units. Designated PM-3A (see Editorial, p. 37), the reactor system can be erected by Seabees in 60 days, can be on full power 15 days later.

PHOTO BRIEFS

M. BARRANGON

Palletless Handling. The pile of bags is on the floor: The truck is about to scoop them up. The new clamping attachment is by the Industrial Truck Division, Clark Equipment Co., Battle Creek, Mich. Maximum capacity: 3500 lb.

Passenger Conveyer. At Balboa Park Zoological Gardens, San Diego, Calif., "Speedramp" units built by Stephens-Adamson Mfg. Company, Aurora, Ill., carry pedestrian traffic the longest distance and up the highest incline to date. Feature: S-A's "floating comb" plate for safety and ease of entry, working in conjunction with a grooved belt made by Goodyear.

Roll Grinder. Looking directly down, you can see the workpiece possibilities of this 24-in. Cincinnati roll grinder used at Baker Perkins, Inc., Saginaw, Mich. It is grinding the hard surfaces of a 9-ft, 4-in. continuous mixer screw, 16-in. diam.

Floating Power Station. A former cargo vessel, the YFP-10 provides electricity for a BMEWS (Ballistic Missile Early Warning System) station. Burns & Roe, Inc., operates the plant under contract to RCA. The 340-ft floating power plant, its propulsion machinery removed, was towed to its operation site.

Diminutive Differential. Ford Instrument Company Division of Sperry Rand makes this $^{3}/_{32}$-in. differential. Of stainless steel, it is engineered to the highest military and commercial standards, provides extreme accuracy, high sensitivity.

Noise Control. This portable noise-suppression system for jet run-up is a product of General Acoustics Corporation of West Los Angeles, Calif. With control units for intake and exhaust, the system can reduce noise levels 10 to 25 decibels at 250 ft without back pressure.

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Multispecimen Creep-Testing Machine

A CREEP-TESTING machine that can accommodate either four high-sensitivity tests or 12 stress-to-fracture tests simultaneously, with one furnace and one temperature controller, has been constructed by the Distington Engineering Company, Workington, England. It will be used primarily by the research and development department of The United Steel Companies, Ltd., Sheffield, of which group the Distington Company is a part.

The machine contains four loading systems, each of which can deal either with one high-sensitivity test or with three fracture tests in series, and can apply loads up to 3 tons on a specimen. A feature of the machine is its compactness; it occupies only slightly more than a sq yd of floor space and can be installed in rows at 4-ft centers. Although it was designed by The United Steel Companies for their own use, it is also being marketed by the Distington Company for general sale to industry and research organizations.

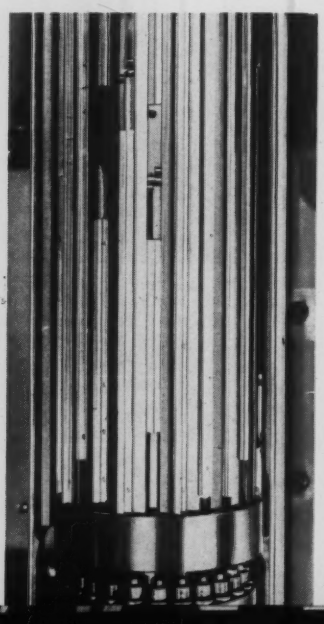
Automatically Positioned Jig Borer

THE Dixi S.A. Usine 2, of Le Locle, Switzerland, claims to be the first firm to market a horizontal optical jig borer—the Dixi 60. The firm has produced a new machine, the Dixi 75 OG, in which increased rigidity, higher spindle speed, and traverse rate are combined with the use of an electronic-hydraulic system for automatic positioning, accurate to 0.00005 in. for linear setting and 1 sec of arc for rotary motion. It is stated that for a movement of about 12 in. the complete setting can be made in about 12 sec, with obvious advantage in the single-piece production of precision parts in a tool room.

An 8-hp motor drives the 3-in. spindle, which has a travel of 18 in. and runs at infinitely variable speeds between 32 and 225 rpm or 225 and 1600 rpm. There are nine reversible spindle feeds and a rapid-traverse rate of 80 in. per min. The table, $39^{3}/_{8}$ in. by 32 in., rotates through 360 deg and has a rapid rotary motion through 180 deg in about 10 sec. The automatic positioning system employs hardened and ground control drums, each with 24 slots to take the position control blocks. One drum controls the vertical position and another the cross motion; a third can be provided if desired for the longitudinal motion, as a depth control for boring or for milling steps. These drums are removable so that they can be stored, if necessary, for a program of work that is to be repeated later.

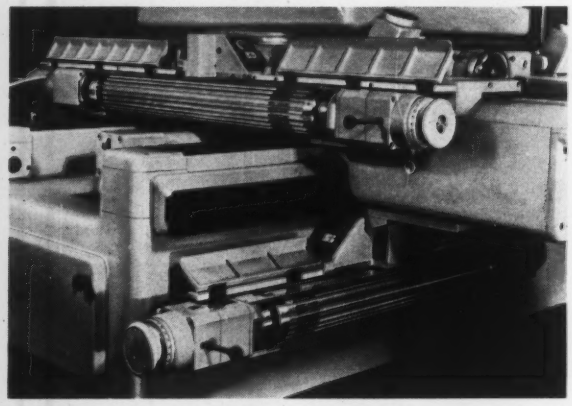
In operation, the successive position control blocks are brought into place opposite to the measuring head, through a coarse and fine adjustment, until the microammeter reads zero. The interaction of the block with the measuring head is purely capacitative, there being no physical contact to disturb the reading, and the opti-

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England



Dixi 75 OG jig borer: Close-up of control drum for vertical motion, showing positioning blocks in slot

Control drums for cross and longitudinal traversing on the Dixi 75 OG jig borer, with protecting covers over drums raised



cal system, also fitted, enables a visual check to be made at any time. To set a dimension when machining subsequent work, it is only necessary to rotate the appropriate drum until the slot for the required dimension is in position, and then to engage the rapid traverse. The table or the headstock, as the case may be, then moves automatically to the correct position.

Boring Lathe for Heavy Shafting

An impressive working exhibit at the recent German Machine Tool Exhibition at Hanover was a boring lathe capable in one pass of boring a hole 10 m (32 ft) long in a shaft weighing up to 40 tons. It was made by Wagner & Co. Werkzeugmaschinenfabrik m.b.H., Dortmund, a subsidiary of the Rheinische Stahlwerke group. The limitations of stand space made it impossible to erect the machine to its full length of 30 m (98 1/2 ft), but the reduced bed length of 17 m (56 ft) was sufficient to demonstrate its capabilities. This was done on a 13-ft length of steel, having a 13 3/4-in. diam and a tensile strength of 51 tons sq in.

The boring tools used are those standardized by the Boring and Trepanning Association (BTA), represented in the United States by the American Heller Corporation, Detroit, Mich., and are made by their German associates, Gebrüder Heller Werkzeugfabrik, of Bremen. The hollow boring bar is held in the tailstock and is supported at the cutting end in a pressure head through which the cooling oil is fed to the carbide cutter. The shaft to be bored rotates around the tool, and the cooling oil, which enters the pressure head in the annular space around the outside of the bar, returns through its hollow center and is discharged into the interior of the tailstock. Thence it falls into a chip-collecting tray with a perforated bottom that travels along below the bed at the speed of the tailstock above it. From this tray the oil falls into a collecting trough, whence it passes over a magnetic drum, through a bar-magnet fine filter, and finally past a system of weirs (the spaces between them acting as settling tanks) before returning to the suctions of the three oil pumps for recirculation.

The headstock contains the drive gearing and the main spindle, on which is shrunk a faceplate having four reversible power-operated clamping jaws. The main drive is by a direct-current reversing motor with Ward-Leonard control, connected to the gearing through a flexible coupling. The feeds and rapid traverse of the boring carriage, like the speed regulation of the driving motor, are infinitely variable. The boring depth and pressure are indicated by conveniently arranged gages. A separate motor traverses the boring-bar guide bearing along the bed.

The centers are 650 mm (25 1/2 in.) above the bed, and a gap provides a maximum swing of 1600 mm (63 in.). The maximum diam of boring bar that can be used is 400 mm (15 3/4 in.) and the maximum rate of feed is 450 mm (17 3/4 in.) per minute.

Holland to Produce Polypropylene

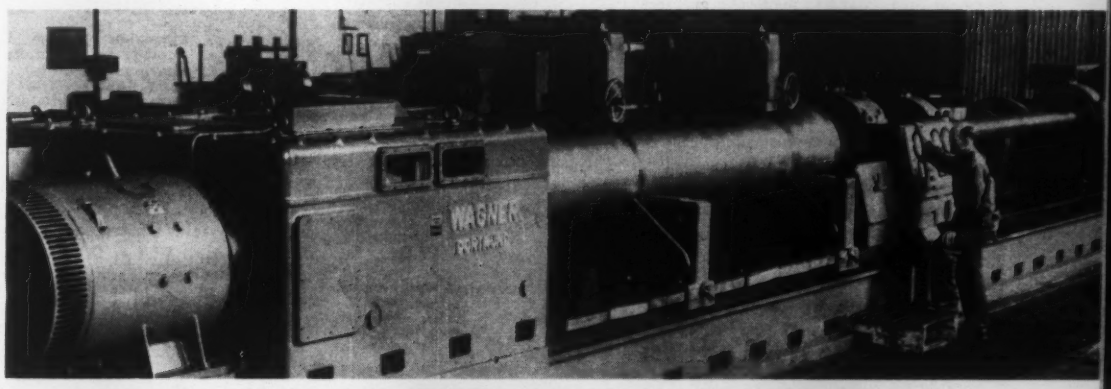
Polypropylene, the lightest of all plastics (specific density 0.9), will be made in Rotterdam, Holland, in a new factory to be constructed by a company formed jointly by Bataafse Petroleum Maatschappij N.V. (Royal Dutch/Shell) and the Italian Montecatini Group, of Milan.

Polypropylene is made directly from propylene, which is derived from oil, using organometallic catalysts of the Ziegler type. The method is covered by Montecatini patents based on the work of Professor Giulio Natta, of Milan University. It has been developed in the Shell laboratories at Amsterdam and in a pilot plant at Pernis.

The product resists temperatures about 60 C higher than low-density polyethylene, and so will withstand boiling water and sterilizing conditions. It is suitable, therefore, for injection-molded articles such as washing-machine parts and hospital sanitary ware. It can be produced in an extremely thin film of high gloss and exceptional transparency. It is envisaged for use in fibers for textiles and rope, and in sheet, pipes, and electrical insulation.

The name of the new company, which is expected to produce for the Benelux countries, will be the N. V. Rotterdamse Polyolefinen Maatschappij. Concurrently, the Shell Chemical Company in the United Kingdom is constructing a plant near Manchester, England, for the production of 30,000 tons of polyolefins a year.

This plant also will make polypropylene, as well as high-density polyethylene, made under Ziegler license, and low-density polyethylene, under license from the Badische Analin und Soda Fabrik, of Germany.



Wagner and Company's shaft-boring lathe, viewed from headstock end. With two roller steadies under the work, as shown, a weight of 40 tons can be accommodated. The shaft to be bored rotates around the tool.

Substance in Brief of Papers Presented at ASME Meetings

ASME TECHNICAL DIGEST

Fuels

A Decade of Electric Utility Fuel Experience..60—Fu-1... By Myles E. Robinson and William L. Kurtz, National Coal Association, Washington, D. C. 1960 ASME-AIME Fuels Conference paper (multilithographed; available to Aug. 1, 1961).

The decade between 1949 and 1958 saw rapid strides in provision by the utilities to meet our mushrooming population and fast-expanding national economy. Nowhere has this been more evident than in the manner of the consumption of the major electric energy-producing fuels. The following study of trends and relationships involved in this consumption is divided into three parts: (*a*) Trends in generation, by type of fuel; (*b*) trends in consumption, by type of fuel; and (*c*) fuel efficiency trends.

The three major fossil fuels, coal, oil, and gas, are examined first for the United States as a whole and then for each of four regions: Middle Atlantic, South Atlantic, East North Central, and East South Central. The regions chosen are those with substantial competition between the three major fuels.

The following conclusions are set forth:

1 Of the three major fuels, based on the heat rate, coal has made the greatest improvement in efficiency with gas second and oil a fairly close third.

2 While the 10-year trends in fuel utilization have established fairly definite relationships between the fuels, a secondary and possibly new trend appears to have started in 1956 and may well alter relationships of the three fuels in the years immediately ahead.

3 Based on improvement in fuel consumption per unit of electric output, coal's greatest gains have been in the East South Central States, oil's greatest growth has been in the South Atlantic region, and gas has made its best showing in the East North Central States.

4 Because of the lack of comparative cost data and the increasing intensity of intrafuel competition for the utility market, projections either of consumption or efficiency would largely be meaningless.

A Concept of Combustion Control for Firing Two Solid Fuels..60—Fu-2... By Carl E. Rodenburg, Mem. ASME, The Rust Engineering Company, Pittsburgh, Pa. 1960 ASME-AIME Fuels Conference paper (multilithographed; available to Aug. 1, 1961).

A system is outlined for controlling the combustion of two solid fuels in a steam-generating unit. The plan is one proposed for a boiler installed in the plant of a large eastern manufacturer of bond paper.

Coal and bark are the fuels used. Bark flows uncontrolled and the coal flow varies with the change in flow of the steam generated for a selected air flow, which is set manually for a given steam output. In turn the coal flow is set by air flow. The rate of flow of this fuel is stabilized when the desired steaming rate is reached.

Undergrate air is measured and a practical minimum is passed through the fuel bed to maintain good combustion characteristics. An oxygen meter monitors the excess air and throttles the overfire air fan damper. Furnace draft is controlled by regulating the induced-draft-fan inlet dampers. Modifications to the original concept made to meet the owner's requirements are also covered. The design parameters and fundamentals the concept is based on are detailed.

The Influence of Volatile Matter on the Combustion of Pulverized Coal..60—Fu-3... By Joseph F. Mullen, Mem. ASME, Combustion Engineering, Inc., Windsor, Conn., and Gregory Gould, Mem. ASME, Fuel Engineering Company of New York, New York, N. Y. 1960 ASME-AIME Fuels Conference paper (multilithographed; available to Aug. 1, 1961).

The authors indicate an approach and present a hypothesis concerning the influence of volatile matter in the combustion of pulverized coal. In the course of their examination of the subject, the complexity of the combustion problem raise numerous questions for which answers are essential before a comprehensive understanding of the phenomena involved can be given.

Of the many problems that occur, the most prominent seem to be:

1 "Fish tails" from the coal burner (ragged flames).
2 "Blow back" or flames that extend back into the burner.
3 Pulsating burners.
4 High carbon losses.

All of these problems are associated in some way with the various chemical, physical, thermodynamic, and thermophysical processes that are involved in the combustion process.

The hypothesis presented, although in somewhat simplified form, helps to explain some of the more common phenomena. The authors conclude that, if sufficient questions are asked and suitable answers developed, the purpose of the paper will have been realized.

Lubrication

Extension of the Conducting Sheet Analogy to Externally Pressurized Gas Bearings..60—Lub-1... By L. Licht, Assoc. Mem. ASME, The Franklin Institute, Philadelphia, Pa. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

Incompressible, viscous flow in narrow passages bounded by parallel surfaces yields the two-dimensional Laplace equation $\nabla^2 P = 0$. The pressure field, load capacity, and lubricant flow of hydrostatic oil bearings can be readily determined by means of the electric analogy of the conducting sheet. The equation

$$\frac{\partial}{\partial x}\left(P\,\frac{\partial P}{\partial x}\right) + \frac{\partial}{\partial y}\left(P\,\frac{\partial P}{\partial y}\right) = 0$$

characterizes laminar, isothermal flow of gas lubricants in otherwise geometrically identical bearings. It is shown that by means of suitable change of the dependent variable this equation can be reduced to the Laplacian form. The ensuing advantage is the extension of the conducting sheet analogy to externally pressurized thrust and journal guide bearings when the lubricant is a gas.

An Assessment of the Value of Theory in Predicting Gas-Bearing Performance..60—Lub-2... By S. Cooper, Rolls-Royce Limited, Littleover, Derby, England. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

The author attempts to indicate the value of theoretical investigations of hydrodynamic finite bearings under steady-state conditions. Methods of solution of Reynolds equation by both desk and digital computing, and methods of stabilizing the processes of solution are described.

The nondimensional data available from the solutions are stated. The outcome of an attempted solution of the energy equation is discussed. A comparison between some theoretical and experimental results is shown. Experimental methods employed and some difficulties encountered are discussed. Some theoretical results are given to indicate the effects of the inclusion of slip velocity, stabilizing slots, and a case of whirl.

Lubrication at High Temperatures With Vapor-Deposited Surface Coatings..60—Lub-4... By D. J. Baldwin and G. W. Rowe, Tube Investments Research Laboratories, Hinxton Hall, Cambridge, England. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME J. Basic Engng.**; available to Aug. 1, 1961).

For many centuries natural oils have been used successfully to lubricate sliding surfaces, but even with the amazingly wide range of natural and synthetic organic fluids available today, temperatures must usually be restricted to 200 C or less.

However, it is possible to compound certain fluids with chlorine, sulfur, and phosphorus, the extreme-pressure additives, whose action is to form protective inorganic coatings either locally or on the whole of the metal surface. These permit sliding at temperatures up to 400 C or sometimes a little higher.

An experimental study of the friction of metals that have been coated with inorganic films by reaction with their surrounding atmosphere is described. The specimens are first cleaned at high temperature in vacuo and then heated in the selected reactive vapor. Many coatings will prevent seizure and give a fairly constant but high coefficient of friction up to high temperatures. Layer-lattice compounds such as MoS_2, $CrCl_3$, and TiI_2 give much lower friction at all temperatures below those at which the film decomposes or evaporates (about 850 C for molybdenum disulphide). A film of boron nitride formed on boron shows a high intrinsic friction, but this can be reduced by certain vapors or by raising the temperature above about 800 C.

Most of the experiments were performed with very light loads but the films are shown to be effective under kilogram loads. A simple indentation test capable of selecting lubricants under loads up to 12 tons is described. This shows that a film formed by heating stainless steel in CCl_2F_2 will lubricate at 400 C when the steel is deformed by over 50 per cent.

Solution of Reynolds Equation for Arbitrarily Loaded Journal Bearings..60—Lub-3... By O. Pinkus, Mem. ASME, General Electric Company, Lynn, Mass. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

The advent of high-speed digital computers has made it practical to obtain workable solutions of the Reynolds equation for finite bearings. Over the years results have been obtained for centrally loaded journal bearings ranging from a full 360-deg bearing down to a 30-deg arc as well as for noncircular bearings. The centrally loaded bearing, however, is only a particular case of the general problem of bearings subject to loads acting in any arbitrary direction with respect to its boundaries.

Here the Reynolds equation has been solved on a digital computer for the case of 150, 100, and 75-deg bearing arcs subject to loads acting in any arbitrary direction. The results cover the entire range of attitudes and load angles and provide solutions for L/D ratios from $1\frac{1}{2}$ down to $\frac{1}{4}$. The application of these basic results to the calculation of the performance of noncentrally loaded partial, grooved, and multilobed bearings is discussed.

Grease Lubrication Studies With Plain Journal Bearings..60—Lub-5... By L. J. Bradford, The Pennsylvania State University; E. M. Barber and J. R. Muenger, Texaco Research Center, Beacon, N. Y. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

Grease-lubricated plain bearings will operate with relatively low coefficients of friction and low lubricant consumption as shown by an experimental investigation on $3\frac{1}{2}$-in-diam bearings.

In the plain-bearing test machine (PBTM) used for this work, the test bearing was between two support bearings and worked against a hardened steel sleeve of 4-rms microin. finish. Contact between sleeve and shaft occurred only on two circumferential lands to minimize bending of the sleeve under load. Loading by a hydraulic system was vertically upward through the bearing and against the shaft. The test bearing holder was floated hydrostatically so that friction torque could be weighed. Drive was by a d-c motor.

Formation of a "rheodynamic" load-carrying film, evidence of thixotropic behavior, and effects of variation of load, speed, clearance, feed rate, and lubricant properties are demonstrated.

A Theoretical Investigation of Pressure Depression in Externally Pressurized Gas-Lubricated Circular Thrust Bearings..60—Lub-6... By Haruo Mori, Kyoto University, Kyoto, Japan. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

In order to gain an adequate understanding of the load capacity and flow characteristics of externally pressurized gas-lubricated bearings, it is necessary to study the pressure distribution in the clearance region. Many previous investigations of pressure distribution have been performed, by the author and others, for various bearing configurations. In general, the familiar equations of viscous compressible flow have shown adequate agreement with experimental results.

However, under some operating conditions, notably high supply pressures and large clearances, a pressure-depression effect has been observed. Rather than continually decreasing with distance from the inlet hole, the pressure drops rapidly following the inlet, then rises again, and finally falls away to atmospheric pressure at the bearing periphery. The occurrence of this depression in the pressure profile is undesirable, since it reduces the load capacity and makes the bearing insufficient in the use of the high-pressure gas supply.

A theoretical explanation of experimentally observed depression of the pressure profile in externally pressurized gas-lubricated circular thrust bearings is presented, based on a concept new to gas lubrication, that of the generation of a shock wave in the bearing clearance space. On the basis of an approximate mathematical model, the bearing pressure distribution and load capacity are determined, and the effects of several bearing parameters are discussed. Good qualitative agreement is found between the analytical results and available experimental data.

The Volume of Stressed Material Involved in the Rolling of a Ball..60—Lub-7... By R. C. Drutowski, General Motors Corporation, Warren, Mich. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

The force necessary to roll a ball on a flat plate is experimentally determined as a function of the load for a number of different ball diameters and steel structures.

Previously published data expressing rolling force as a power of the load and ball diameter are shown to be inadequate in describing the behavior of the rolling ball over the full-load range employed in this investigation. The rolling force is found to be negligible for contact stresses less than a certain "threshold" contact stress. Once the rolling force becomes measurable, it is shown to be proportional to the volume of significantly stressed material until a contact stress is attained which is sufficient to cause plastic deformation.

The significantly stressed volume is determined from the distribution of the strain energy stored in the Hertzian stress field of a ball in contact with a flat plate. The threshold contact stress, the constant of proportionality between the rolling force and significantly stressed volume, and the contact stress at which plastic deformation is initiated are shown to be independent of the diameter of the rolling ball but dependent on steel structure. A model is introduced relating the volume of significantly stressed material to elastic hysteresis processes responsible for energy loss during rolling.

Gear and Bearing Lubrication in Extreme Environments With Polyphenyl Ethers..60—Lub-8... By J. B. Accinelli, V. N. Borsoff, W. W. Kerlin, and S. J. Beaubien, Mem. ASME, Shell Development Company, Emeryville, Calif. 1960 ASME-ASLE Lubrication Conference paper (multilithographed; available to Aug. 1, 1961).

The rapid advance in aircraft and space technology has brought many problems to the designers and builders of machine components for highly stressed systems. One of these problems is that of lubricating elements such as gears and bearings at extreme temperatures and in an oxidizing atmosphere. Moreover, there are some systems where the severity of the environment is compounded by the presence of high levels of ionizing radiation. Conventional lubricants cannot meet this challenge. Thus there is a pressing need for information on the lubrication characteristics of selected fluids that have shown promise in laboratory oxidation and thermal-stability tests, and about which little or no data on performance in actual machines are available.

Among the most promising of the new fluid types proposed as lubricants is a class of compounds known as unsubstituted polyphenyl ethers. The work described in this paper was principally directed toward evaluating the ability of two of these ethers to lubricate spur gears and high-speed ball and roller bearings under conditions of severe thermal, oxidation, and radiation stresses.

Three spur-gear machines were used to evaluate the performance characteristics of the lubricants. A high-speed spur-gear machine was used to measure the load-carrying capacity; a special high-temperature machine was employed for tests above 400 F; and a third machine was instrumented and shielded for use with radioactive gears so that the wear characteristics of the gear oils could be established.

An Improved Analytical Solution for Self-Acting, Gas-Lubricated Journal Bearings of Finite Length..60—Lub-9... By J. S. Ausman, Assoc. Mem. ASME, Autonetics, Division of North American Aviation, Inc., Downey, Calif. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

In 1957, the author obtained a first-order perturbation solution for finite, self-acting, gas-lubricated journal bearings by neglecting products of pressure variations and film-thickness variations. This perturbation solution has several glaring defects, which are as follows:

(*a*) Predicted pressures are symmetric about the ambient pressure $p\hat{a}$, whereas actual pressures are known to be asymmetric with the high pressures being accentuated.

(*b*) Predicted bearing stiffness is independent of eccentricity (straight-line, load-eccentricity characteristic), whereas actual bearing stiffness increases at high eccentricity ratios.

(*c*) Predicted attitude angle is independent of eccentricity, whereas actual attitude angles decrease at high eccentricity ratios.

An improved analytical solution, which largely eliminates these defects, is obtained in the present paper. The solution is accomplished by linearizing the differential equation in a different manner. Instead of keeping the pressure p as the dependent variable, the product ph of pressure and film thickness h is treated as the dependent variable. The resulting solution is called the "linearized ph" solution.

Whereas the older first-order perturbation solution is useful for small eccentricity ratios ($\epsilon < 1/2$), the linearized ph solution may be used for high eccentricity ratios. As such it permits estimation of ultimate bearing load capacity. The linearized ph solution is expressed in the form of simple corrections to the first-order perturbation solution, and as such can be computed quickly and easily.

Performance of Elastic, Centrally Pivoted, Sector, Thrust-Bearing Pads—Part 1..60—Lub-10... By B. Sternlicht and E. B. Arwas, Assoc. Mems. ASME, General Electric Company, Schenectady, N. Y.; and J. C. Reid, Jr., Bureau of Ships, Washington, D. C. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

This is the first of three papers on the results of a recently completed study of the performance of tilting pad thrust bearings. It describes a method of analysis that was worked out for these bearings, which includes viscosity variations in the fluid film and an approximate calculation of the pad deflections caused by the hydrodynamic pressures. Equilibrium of moments is satisfied, laminar and adiabatic conditions are assumed, and the lubricant is incompressible.

The two subsequent papers of this series will describe: (*a*) The results of an analysis which includes a more rigorous determination of pad deflections caused by hydrodynamic pressures and thermal gradients. (*b*) A comparison of analytical results with experimental data obtained in full-scale bearing tests.

Consideration of the Starting of Gas Lubricated Bearings..60—Lub-11... By M. Wildmann, Assoc. Mem. ASME, Autonetics Division, North American Aviation, Downey, Calif. 1960 ASME-ASLE Lubrication Conference paper (multilithographed; available to Aug. 1, 1961).

The starting and stopping of self-acting gas-lubricated bearings differs from the starting and stopping of oil-lubricated bearings in that there is usually a complete absence of a lubricant having boundary lubricating properties. The frictional energy generated by the sliding of the two bearing surfaces has therefore to be absorbed by these surfaces.

This metal-to-metal contact generates wear particles and can cause bearing deformations. These effects are very undesirable, particularly if the close tolerances and small clearances usually associated with hydrodynamic gas bearings are taken into account.

The forces acting on a gas-lubricated journal bearing at start are examined, and an expression for the frictional energy dissipated on the bearing surfaces is obtained. Examination of this expression indicates that for a full gas-lubricated journal bearing, this energy is always less when the outer member rotates.

The Effect of the Method of Compensation on Hydrostatic Bearing Stiffness..60—Lub-12... By Stanley B. Malanoski and Alfred M. Loeb, Assoc. Mem. ASME, The Franklin Institute Laboratories for Research and Development, Philadelphia, Pa. 1960 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1961).

In many applications of hydrostatic (externally pressurized) bearings the nature of the slope of the load-film thickness (deflection) curve is an important consideration. The numerical value of this slope, called stiffness, indicates the ability of the bearing to resist a change in load with a related change in film thickness.

Capillary, orifice, and flow-control valve compensation of hydrostatic thrust bearings is investigated theoretically with regard to the effect of these three methods of compensation on the stiffness of the lubricant film. Equations are derived which permit rapid determination of bearing stiffness at any given load and film thickness.

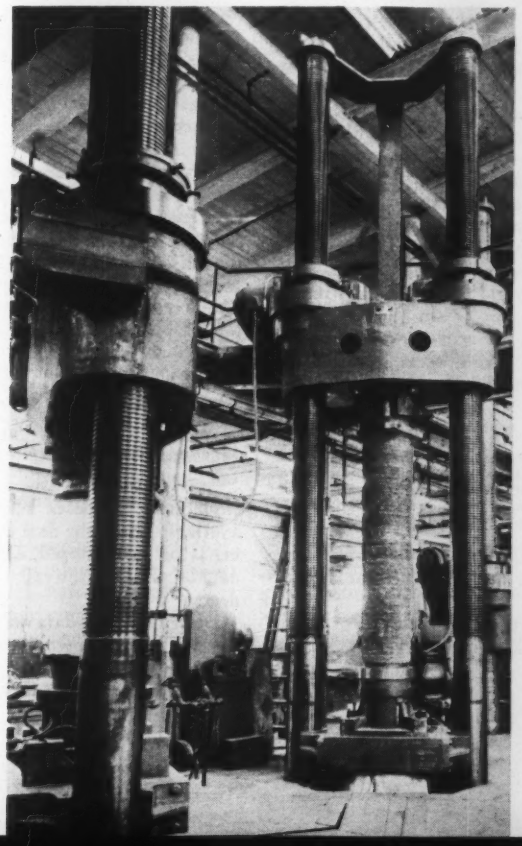
When a hydrostatic bearing is made to operate at any given film thickness and load, it is found that at this load and film thickness no adjustment of the compensating element or supply pressure will alter the fact that $\psi_{valve} > \psi_{orifice} > \psi_{capillary}$, where ψ equals the absolute value of stiffness. Furthermore, with fixed supply pressure and compensation, this stiffness relationship will remain the same for all practical values of load above and below the initial film thickness-load point.

Adsorption of Polar Organic Molecules on Machined Metal Surfaces and Properties of the Resulting Surface Films..60—Lub-14... By Hilton A. Smith, The University of Tennessee, Knoxville, Tenn.; and Roy L. Bennett, Union Carbide Nuclear Company, Oak Ridge, Tenn. 1960 ASME-ASLE Lubrication Conference paper (multilithographed; available to Aug. 1, 1961).

When most metals are machined under hydrocarbon solutions of fatty acids, surface monolayers result. Soap molecules are formed that may be desorbed. Further reaction of acid with metal maintains monolayer coverage.

This reaction is due to Kramer activity; that is mechanical activation of metals. Comparison of "exchange" rates measured by radiochemical techniques and desorption rates measured by microanalytical experiments indicates active surface spots. These might be regions on a smooth surface or points of contact of the monolayer with rough surfaces. Experiments with n-hexanoic acid indicate that bridging is improbable. Examination of copper surfaces, machined under inert-solvent or fatty-acid solutions, by reflection electron diffraction or electron microscopy, shows that the surfaces are indeed smooth and hence contain regions of unusual activity.

Two 1500-ton presses with adjustable heads for manufacture of filled paper rolls for paper calendar stacks (60—RP-3)



Perturbation Solutions for Gas-Lubricating Films..60—Lub-13... by W. A. Gross, Mem. ASME, IBM Research Laboratory, San Jose, Calif.; and E. C. Zachmanoglou, University of California, Berkeley, Calif. 1960 ASME-ASLE Lubrication Conference paper (multilithographed; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1951).

One of the most powerful tools for analysis of nonlinear equations is the method of perturbations.

Perturbation solutions for large and for small bearing numbers are developed and applied to steady, self-acting, infinitely long, journal and plane-wedge films. Bearing films of this type develop load capacity as a consequence of relative surface motion. The solutions given here have validity for all ranges of geometrical parameters. Four-place accuracy in determining the load carried by a journal bearing is achieved. The plane-wedge-film solution for large bearing numbers is complicated by the reduction in order of the limiting equation. A boundary-layer-type analysis yields fairly accurate results.

Rubber and Plastics

Presses in the Rubber and Plastics Industry..60—RP-3... By Everett Periberg, Adamson United Company, Hackensack, N. J. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

Processing of hot materials necessitating heated platens or molds involves many problems in press design. The simpler ones require cooling of closed-circuit hydraulic fluids, drilling of platens and molds, and heating connections. The problems become more complex, however, as temperatures rise.

Recognizing some of the problems inherent in press design as a result of extreme accuracy of processing rubber and plastics, this paper discusses a number of the features that can be incorporated in presses to improve their operating efficiency and to produce more accurate parts. It deals exclusively with compression and transfer-type presses, bearing in mind that virtually all of this type equipment is subject to problems of thermal expansion, and some to problems of alternate heating and cooling cycles.

Elastomeric Gyro Suspensions..60—RP-6... By James T. Gwinn, Jr., Assoc. Mem. ASME, Lord Manufacturing Company, Erie, Pa. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

Types of gyro mechanisms mainly in use are the gim-balled-axis gyro and the fixed-axis gyro. Since these devices are used for purposes of directional reference, it is extremely important to maintain the initial alignment of the unit with respect

to the support on which it is installed. This is particularly necessary in the case of fixed-axis gyros. Such a requirement would seem to be a "hard" or rigid attachment to the supporting structure. However, if such an attachment is made, the mounted gyro must be subjected to the vibration and shock the supporting structure experiences.

Instead, resilient suspension systems are used to obtain the necessary protection.

Although the use of such systems may create other problems, particularly where gyros are concerned, the benefits possible through the use of a properly designed suspension far outweigh the disadvantages. A very efficient type of suspension system may be obtained by using mountings with a highly damped elastomer as the resilient member. Through the use of special elastomer formulations, the combined advantages of mechanical simplicity, silent operation, inherent material damping, high isolation efficiency, and constant performance over broad temperature ranges may be realized for various types of suspension configurations.

The requirements of resilient suspension systems for the protection of gyro equipment are stated and reviewed in detail. The typical performance of highly damped elastomeric suspension systems are described and compared to these general requirements.

Obtaining Stress-% Compression Diagrams of Foamed Plastics at High Rates of Compression . . 60—RP-9 . . . By R. C. Dove, Assoc. Mem. ASME, and W. E. Baker, University of New Mexico, Albuquerque, N. M.; and C. D. Beaman, Assoc. Mem. ASME, Creole Petroleum Corporation, Maracaibo, Venezuela. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

The widespread use of foamed plastics as cushioning and packaging material has made the knowledge of their dynamic properties imperative. One method of understanding how the rate of compressive loading affects behavior is through the stress per cent compression diagram.

Stress per cent compression curves determined from tests using universal testing machines may be misleading because of the low rate of compression used during the test as compared to that encountered in cushioning problems. Several test devices have been proposed and used to evaluate material properties at high rates. However, in most of these devices the rate of straining is not as great as in certain cushioning applications, or it has been impossible to control the shape of the strain-time curve so as to duplicate a type of loading.

A test machine is described that will load specimens in compression at rates as high as 30 ips or 6000 per cent/sec for a one-half-in-thick sample. The rate of compression and the shape of the per cent compression-time curve is readily varied. The stress per cent compression diagram associated with any given per cent compression-time curve is plotted directly. An impact method which has been used to obtain stress per cent compression diagrams with compression rates as high as 200,000 per cent/sec is discussed.

The most obvious shortcoming of the variable-rate testing machine described is its rather low upper limit of compression rate, which is imposed by the excessive vibration and impact forces resulting when tests are run with flywheel angular velocities of greater than 1000 rpm.

Fillers and Stresses in an Epoxy Resin . . 60—RP-11 . . . By John E. Rutzler, Jr., and Leonard C. Feinstein, Case Institute of Technology, Cleveland, Ohio. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

Fillers, such as metallic oxides, rubbers, carbon, cellulosic materials, asbestos, and epoxy and other resins, are employed extensively in the practical compounding of adhesives in order, among other effects, to increase tackiness, to reduce shrinkage, to increase impact and tensile strengths, and to increase thermal stability.

Effects such as these are believed to be produced by distributing stress concentrations more evenly in adhesive bonds, by reducing the thermal coefficient of expansion of the organic adhesive material, and by increasing its modulus of elasticity.

An investigation has been made of the effects of a flexible and a rigid filler upon the strengths of bonds between aluminum rods when ruptured in tension. Evidence is presented to show that stress concentrations around filler particles play a major role in the attainable strength of the filled epoxy resin studied. The effect of the rigid filler on bond strength depends, in part, upon the amount of curing agent used in the resin and on whether the curing agent is mixed initially with the resin or with the filler.

Elastomers as a Structural Material . . 60—RP-12 . . . By E. E. Thielker, E. I. du Pont de Nemours and Company, Inc., Elastomers Laboratory, Wilmington, Del. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

A general discussion is presented on the use of elastomers in structural applications.

The distortion and recovery of elastomers are unique characteristics essential in damping vibration. "Floating" rooms resting on elastomer mounts have become a necessity to protect sensitive equipment to meet the exactness required in precision testing and experimentation.

The design of a more effective, more economical, and maintenance-free bearing for bridges is discussed to illustrate the use of elastomers in rather rugged service. The combination of physical properties, weathering resistance, and load-bearing capacity of neoprene vulcanizates dictates its use as a bearing material. Modern structural applications, some unique, indicate the variety of uses to which elastomers can be put to meet exacting tolerances.

Principles of Processing Liquid Urethane Elastomers . . 60—RP-13 . . . By J. A. Hanzel, Assoc. Mem. ASME, E. I. du Pont de Nemours and Company, Inc., Elastomers Laboratory, Wilmington, Del. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

The physical state of liquid methane elastometers makes them unique in the family of elastomers.

The fact that they are processed in the form of liquids offers a new degree of freedom for the elastomer process engineer. Processing of a fluid presents problems to be sure, but it also frees the engineer from much of the heavy conventional rubber-processing equipment with its high capital investment.

Liquid-urethane processing involves mixing a liquid-urethane polymer and fluid curing agent. The mixture is discharged at atmospheric pressure into a mold and oven cured without pressure to form a finished molded product. Several urethane polymers in combination with various curing agents provide a series of products representing a broad range of vulcanizate physical properties.

This paper has been drafted to assist the process engineer by providing the basic requirements necessary to process the fluid-urethane elastomers. The author discusses the general physical characteristics and handling procedures for liquid polymers and curing agents, and liquid-urethane molding techniques.

Design Strength Data and Calculations on Thermoplastics . . 60—RP-15 . . . By W. D. Harris, The Dow Chemical Company, Midland, Mich. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

New materials useful for design and engineering purposes are always made available before the data describing their behavior is developed. Many types of data on plastics are available to the engineer.

Design strength data on thermoplastics can be broken down into three classes

according to the type of behavior that is anticipated in the application. These are: (*a*) Static loading, (*b*) high-speed or shock loading, and (*c*) fatigue.

It is the purpose of this paper to discuss the design strength of thermoplastics under static load and to give a simple, inexpensive method for obtaining these data.

Automotive Engine Mount Design.. 60—RP-20... By A. L. Everitt, Inland Manufacturing Company, Dayton, Ohio. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

The engine mount is an important key part in any automotive structure. Functionally, a mount can be described as follows: (*a*) It is a basic structural member. (*b*) Its over-all functions must be keyed with the suspension, frame, body, transmission, and final drive. (*c*) The whole package, properly allied, provides the quiet, comfortable car of today.

A brief résumé of the engine mount's companion parts is given here, including materials and design factors.

The Analog Computer and Its Application in the Rubber and Plastics Industry.. 60—RP-21... By Adolph Katz and Paul Berthiaume, Electronic Associates, Inc., Princeton Computation Center, Princeton, N. J. 1960 ASME Rubber and Plastics Conference paper (multilithographed; available to Aug. 1, 1961).

The general purpose analog computer is a modern engineering tool that can be used effectively for the design, synthesis, and analysis of physical systems. By connecting a series of operational blocks, which comprise the analog computer, in an arrangement satisfying the postulated relationships of a physical or mathematical system, a model of that system is obtained. Experiments can then be conducted with the model to determine appropriate parameters for high stability and performance and to establish the critical parameters and their sensitivity on the response of the system.

The authors define the general nature of the components available in the computer as well as basic programming procedures to model the physical or mathematical systems of interest. Then they describe some typical applications in the rubber and plastics industry.

Petroleum

New Instruments Improve Depth Accuracy..60—Pet-5... By William E. Bowers, Schlumberger Well Surveying Corporation, Houston, Tex. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Two new instruments have been developed that will improve the accuracy of borehole depth measurements. One device, the automatic cable marking tool, is used in field locations to measure and mark cables. The other device, the cable testing machine, is a laboratory instrument used to determine the effects of temperature and tension on cable length. These laboratory data are used to make small corrections to the depth obtained from marks on the cable. These new instruments are now in use and will contribute to consistently more accurate depth measurement.

The author describes the instruments and, to show their role in obtaining precise depth control, reviews the principles involved in one of the preferred methods of depth measurements.

Models—A Basic Tool in Process-Plant Design..60—Pet-3... By Donald J. Fries, Assoc. Mem. ASME, Foster Wheeler Corporation, New York, N. Y. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Four basic types of three-dimensional scale models are used to benefit the design and construction of petroleum and chemical-process plants.

These types are known as plant layout, check, display, and piping-layout models. The plant model mainly consists of a tabled area representing the land available and models of contemplated equipment and structures that are movable so as to develop a desired equipment and structure location. The display model is, as the name implies, to be used as an advertising medium or show piece to indicate to potential clients the type of units designed by an engineering firm, or proposed by a petrochemical organization.

The check model is developed after the completion of all construction drawings as a check to see if the components provided for a given unit will fit together when all material has been delivered to the construction site.

The piping-layout model is the type most commonly used in the process-plant design field at this time. This type of model replaces extensive planning drawings which are required to indicate to the customer and the rest of the engineering organization what the mechanical-design department is proposing.

The preparation, construction, and various uses of models are briefly discussed.

The Mechanical Aspects of Rig Moves.. 60—Pet-4... By Marvin T. Parker, Great Western Drilling Company, Midland, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The primary function of a rotary drilling rig is to drill holes for the production of oil or gas. The design of a rotary rig would be easier and possibly much more economical if the unit did not have to be moved.

Rotary rigs of today quite often move every week, but occasionally remain on one location in excess of two years. The cost per foot of hole when moving often will be higher than on extended operations and the moving expense can amount to 20 per cent of the total footage cost in some areas. The operators of rotary rigs have been compelled to watch moving expense more in the past few years than ever before. The over-all operating expense has increased while the revenue per foot of hole has decreased.

Two decades ago, one could find almost as many different rig-up designs and moving techniques as there were supervisors. During the past few years the trend has been to standardize rig-up designs and design each rig so that it can be moved and assembled quickly with a minimum cost. The influence of the design engineer has now followed the rotary rig into the field where it will be used and moved.

The author outlines some improvements for the present, and calls for more economical moving and assembly methods for the future.

Automation for Liquid Pipe Lines .. 60—Pet-6... By James F. Stephenson, Gulf Oil Corporation, Pittsburgh, Pa. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Automation has developed rapidly in recent years in all phases of industry.

In the oil industry, refinery-process control was the first application of automation and it is considered that, because of the long experience gained in this field, this phase of the industry is considerably advanced in automation techniques.

The pipelines are rapidly progressing in their efforts to fully automate operations; however, much remains to be done. There are many problems unique to pipelines that need to be solved. The selection and application of suitable automation equipment are one.

The author discusses remote, partial, and centralized control of pumping stations, as well as satellite and monitored control. Recommendations are made for future pipeline design.

Solid Films—Lubricants for Extreme Environments .. 60—Pet-10 ... By C. F. Merrill and Robert J. Benzing, Wright Air Development Division USAF, Dayton, Ohio. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The term "solid film lubricants" designates a series of lubricating materials consisting of a friction-and-wear-reducing pigment, such as graphite or molybdenum disulphide, bonded to the bearing surface with some type of adhesive.

The authors review the area of solid film lubricants, their present use, and requirements for future developments. Particular emphasis is placed on application in military programs. Solid films are currently in wide use in military vehicles with most applications being found in slow sliding bearings at loads from 2000 to 80,000 psi. Present films have long-term capabilities at temperatures to around 400 to 600 deg F depending upon the specific application. The development efforts to be reviewed are being carried out in the 1000 to 2000 deg F temperature range. It is in this particular range that solid films offer considerable promise above and beyond the use of such standard lubricants as greases and oils.

Practical Aspects of the Heat Treatment of the High Speed Steels .. 60—Pet-11 ... By Dale C. McKissick, Reed Roller Bit Company, Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Steels of approximately the same composition as today's tungsten high-speed steels were first manufactured in the 1890's.

These steels were heat-treated in the manner now used for alloy tool steels and a hardness of only Rockwell C42 was obtained. It wasn't until 1907 that metallurgists discovered that a high-temperature heat-treatment will produce the high hardness of Rockwell C65, even after tempering and using at a dull-red heat.

The tools could then be used at high turning speeds and not immediately lose their hard cutting edge.

The author proposes four requirements of quality heat-treating of high-speed steels and some methods of checking that these requirements are being met. The four requirements are that the steel be heated uniformly to the proper temperature; that it is uniformly quenched; uniformly tempered for a sufficient length of time; and protected against carburization and decarburization.

Cemented-Oxide Cutting Tools; Where They Stand Today .. 60—Pet-12 ... By G. A. Morrison, General Electric Company, Detroit, Mich. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

A powerful resource for reducing machining costs in general—for machining the "unmachinable," and sometimes for eliminating grinding—cemented oxides are now moving into their correct place in metal cutting.

While they are not a cure-all, they meet certain needs as does no other tool material.

An excellent example of what cemented oxides can do is in machining automotive brake drums. Here they have slashed costs, speeded production, and improved the finished product to the point where they have become the standard tooling for the job. This operation was one of the first production jobs assigned to cemented carbides during their introduction 30 years ago.

The characteristics and uses of cemented oxides, and the design of tool holders are discussed.

It is concluded that increasing need for faster, lower cost machining everywhere insures growing use of these oxides.

Design Application of Engine-Driven Balanced-Opposed Gas Compressor for Pipeline and Process Installations.. 60—Pet-14 ... By W. M. Kauffmann, Mem. ASME, Worthington Corporation, Buffalo, N. Y. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The concept of a power engine driven compressor unit, to supplement the popular angle gas-compressor engine, has gained acceptance in some recent process and pipeline developments.

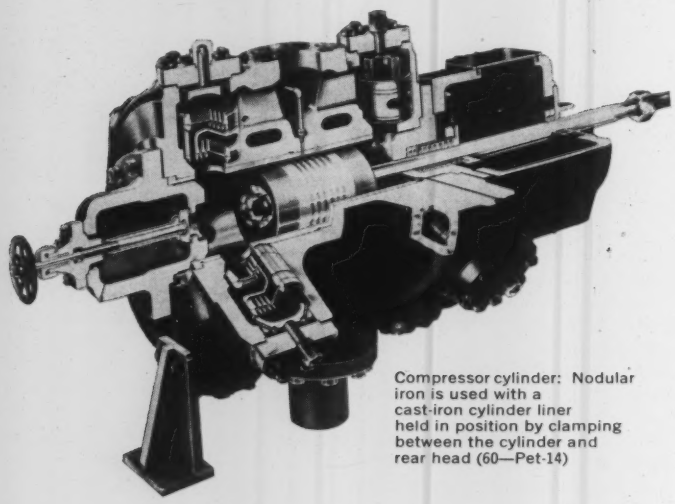
This pertains to both in-line and V-type applications and has been partly due to the accelerated development and research gains made in the field of turbocharging of two-cycle and four-cycle gas engines, with resultant reduced fuel consumption and increased power output per cubic inch displacement.

The author reviews the design characteristics of unitized drive applications for both two-cycle and four-cycle power engines and explores the relative advantages and disadvantages that accrue with this type of installation.

An Automatic Control System for a Gas Pipeline Compressor Station .. 60—Pet-15 ... By K. S. Hagius and L. R. Henry, Mem. ASME, Colorado Interstate Gas Company, Colorado Springs, Colo. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Colorado Interstate Gas Company has recently installed an automatic control system. This installation was made after several years of study to determine the role of automation in the operation of gas-transmission system. These studies culminated in the decision to install automation apparatus in future facilities. The prototype control system was installed at the control center or dispatch office and at the Springfield compressor station. It has been in operation since April, 1960.

This paper summarizes the studies leading to the decision to use automation concepts, and outlines the particular plan of control that was employed. A description of some of the features of the control system as installed at Springfield is also included.



Compressor cylinder: Nodular iron is used with a cast-iron cylinder liner held in position by clamping between the cylinder and rear head (60—Pet-14)

Some Results on Continuously Drilled Fixed Tube Plates .. 60—Pet-16 ... By G. D. Galletly, Assoc. Mem. ASME, and D. R. Snow, Shell Development Company, Emeryville, Calif. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The plates used to separate the tube and shell-side pressures in heat exchangers or reactors are usually circular, of constant thickness and perforated by many holes.

To design these perforated tube sheets, most methods used today assume that the perforated plate can be replaced by some equivalent unperforated plate. The main part of the design is then concerned with the prediction of the maximum stress that will occur in the equivalent plate and, from this, the maximum stress in the actual plate.

Results of strain gage measurements taken during the hydrostatic proof-test on the tube plate and tubes of a full-scale heat exchanger have been analyzed. Theoretical stress calculations, based on the ligament-deflection efficiency method and the equivalent plate-constant method, were also made, taking into account the elastic restraint at the edges of the plate. Agreement between theory and experiment appeared to be best when the ligament-deflection efficiency method was used. However, the incompleteness of the data made it difficult to determine the relative merits of the two theoretical methods. It is strongly recommended that further model and full-scale tests be conducted so that a rational and experimentally verified design method for these structural elements can be obtained.

Ultrasonic Testing .. 60—Pet-17 ... By C. E. Lautzenheiser, Dow Chemical Company, Freeport, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Nondestructive testing is a broad field with many methods of application. Some of these methods are visual, dye penetrant, magnetic particle, eddy current, radiography, electrified particle, and ultrasonics.

These tests can measure dimensions, mechanical and chemical properties, quality, presence of discontinuities and/or serviceability of a test object. A complete coverage of the entire subject is found in the "Nondestructive Testing Handbook," edited by Dr. R. C. McMaster, and in an ASME handbook, "Metals Engineering—Design."

Only ultrasonic testing, its operating principles, and some of its applications are discussed here.

Ultrasonic testing equipment is moderate in price and dependable in operation. It is concluded that the capital cost of the equipment and its operation can be justified in the saving of labor performed on defective material, salvage of usable pipe and pressure vessels, and the reduction of down time of a unit by differentiating between usable and nonusable material.

Technical Computer Applications In Exploration and Production .. 60—Pet-19 ... By W. S. Pickrell, International Business Machines Corporation, Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Petroleum firms in the United States and in some of the foreign countries have come to realize that the high-speed digital computer is an important tool for their engineers. Presently, there are approximately two hundred computers installed and performing various applications in all phases of the petroleum industry. Most important, the computers are profitable for the companies, by making it possible to solve important problems heretofore impossible, and by saving engineering man-hours.

The author discusses some of the more common and important applications in petroleum exploration and production.

Two factors that represent improvement due to computer usage are defined. The first is the work-amplification factor, which is defined as the ratio of the man-years of hand calculation work produced on the computer to the man-years required to set up the basic analysis and perform the work on the computer. The other is the cost-reduction factor, which is defined as the ratio of the cost of performing a unit of work using hand-computation methods to the cost (including the prorated cost of the computing facility) of performing the same work on the computer.

Computer Simulation of Marine Terminal and Pipeline Operations of the Trans-Arabian Pipe Line Company .. 60—Pet-20 ... By Donald W. Dreier, Trans-Arabian Pipe Line Company, Van Cortlandtville, N. Y., and Brice A. Sachs, Esso Research and Engineering Company, Madison, N. J. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

A mathematical simulation model is described of the Tapline system, which was recently developed as the product of an operations research study by the Esso Research and Engineering Company and the Trans-Arabian Pipe Line Company.

The model, which has been programmed for the IBM 704 computer, will be used in a case-study manner to evaluate possible investments in physical facilities and to measure the incentives for revising operating practices or procedures. Elements of the model representing the four pipeline sections and associated pumping stations and tankage, and the tankage and shiploading facilities of the Sidon Terminal are explained. Several case studies, made under representative conditions derived from 1958 data, and an example of use of the model for facilities evaluation are discussed.

How Economics Influenced the Design of a 15,000-psi Blowout Preventer .. 60—Pet-24 ... By R. C. Brooks and G. E. Nevill, Mems. ASME, Cameron Iron Works, Inc., Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

A satisfactory design must provide both functional and economical solutions to the users' problems.

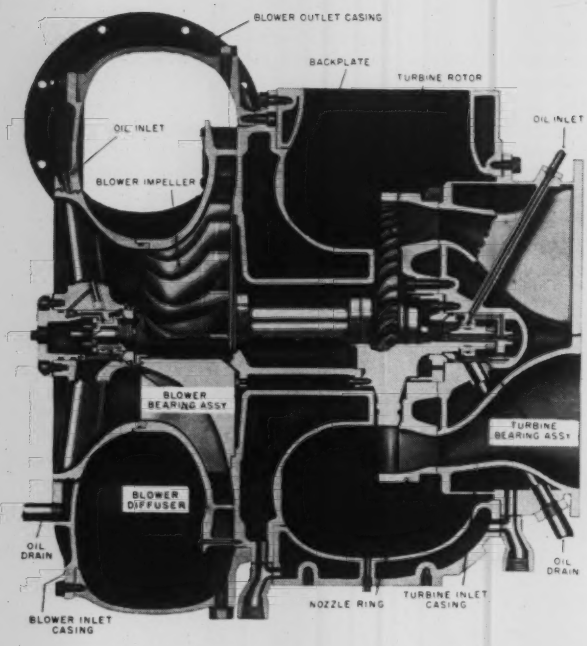
The design and development of the Cameron type "F" blowout preventer is cited as an example wherein design features such as balanced pressure forces, removable and interchangeable operators, and use of high-strength alloy steel parts are combined to meet the functional requirements, at the same time satisfying the economic requirement by compactness, reliability, easily removed subassemblies to facilitate shipping, handling, and servicing, and by providing maximum latitude in combinations or physical arrangement with other equipment.

Computer Program to Determine the Throughput Rate of a Heated Pipeline .. 60—Pet-25 ... By Dennis R. Horner and Paul Fried, Bataafse International Petroleum Mastschappij (Royal Dutch/Shell), The Hague, Netherlands. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

There is no short yet accurate method for calculating the throughput of a heated pipeline.

Many pipelines operate to a pumping schedule in which liquids with widely differing viscosities are handled. In a heated system the calculations to determine the mean throughput rate are very time-consuming, especially if discontinuities such as intermediate pump stations, and heaters, pipe-diameter changes, and varying thermal conductivity of the ground are also present. A program has therefore been written to do this calculation using the IBM 650 computer. The results give the complete hydraulic characteristics of the pipeline throughput, the pumping schedule, as well as the over-all average throughput rate. Thus as well as simulating operating conditions, the program may also be used for design purposes.

This is a quicker, easier way of doing the conventional calculations, not a new theory of pipeline computation.



Cross section of a typical exhaust-driven turbocharger showing blower impeller and turbine disk mounted on a common shaft. The complete unit, called the rotor, is mounted on the engine and piped up so that engine exhaust gases drive the turbine disk, and the impeller delivers air through the air manifold to the engine cylinders. The air manifold pressure available to the cylinders is the most important maintenance check to be made on a turbocharged unit (60—Pet-31).

Stress Analysis of a Cylindrical Shell-Ring Stiffener ... Application to Oil Storage Tanks .. 60—Pet-26 ... By Isaac M. Daniel, Armour Research Foundation, Chicago, Ill. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The author's objective is to determine the bending moment in a ring stiffener of a cylindrical shell. In particular, a cylindrical shell, clamped at one end and reinforced with a flexible ring stiffener at the free end, was analyzed for two types of loading: General ring loading in the plane of the ring symmetrical about a diameter, and normal loading on the shell uniform along the length and symmetrical about an axial plane.

Theoretical and experimental results for a uniform line load on this shell were compared. The theory developed was applied to the case of the open-top tank wind girder. Maximum moments in the girder due to wind load were determined and plotted for a wide range of geometrical parameters.

New Developments in Surface and Subsurface Storm Chokes..60—Pet-27... By Phillip S. Sizer, Mem. ASME, and W. W. Dollison, Otis Engineering Corporation, Dallas, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

In the past few years, users of safety equipment have recognized a need for new concepts in subsurface and surface safety equipment.

This trend has been brought about by development of new producing areas where previous equipment has displayed some heretofore unrecognized limitations. These new areas have either introduced or increased the seriousness of problems of corrosion, erosion, sand production, higher pressures, and increased production. New equipment is being developed in an effort to solve these new problems.

The authors discuss this equipment and define and classify designs. All safety devices can be classified broadly as "diverted flow" or "straight flow." "Diverted flow" is herein defined as that flow which is caused to move in any direction other than a straight line; while conversely, "straight flow" is defined as that flow which is allowed to move in a straight line without direction change.

The trend in the design of new equipment is toward "straight flow." It is seen that the poppet, sleeve, and needle-valve closures will cause diverted flow; while the ball, flapper, plug, gate, and ball-check closures will provide straight flow.

The Design of Semi-Permanent Gas Compressor Stations..60—Pet-28... By J. L. Joplin, Oil and Gas Supply Company, Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The majority of semipermanent gas compressor installations utilize compressors driven by separate multiple-cylinder, 4-cycle, high-speed gas engines, not integral engine-compressors.

Although many of the points covered here will apply to the integral units that are unitized for semipermanent use, only separately driven machines will be discussed.

Major points that may be used as a guide in writing specifications and in considering proposals from various suppliers are covered, with suggestions for proper sizing. Each component required for correct installation is discussed.

Sulfur Recovery From Petroleum Gases ..60—Pet-29... By Robert A. Graff, Graff Engineering Corporation, Dallas, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed, available to July 1, 1961).

Hydrogen-sulfide bearing gas, obtained as a by-product from the desulfurization of gaseous or liquid hydrocarbons, now provides an important raw material for the manufacture of elemental sulfur. Possible revenue from this source, as well as the abatement of an air-pollution problem, has resulted in numerous sulfur-recovery plant installations being made at oil refineries and natural-gas-processing installations during the past few years.

Current sulfur-recovery practices are reviewed and evaluated, as applicable to the conversion of hydrogen sulfide to elemental sulfur. Simplified flow diagrams covering three types of commercial processes are presented. Information covering general equipment design is included, as well as methods for handling the recovered sulfur product. Data covering the probable plant investment and processing costs are also presented.

It is concluded that the simplicity of the processes reviewed, their relative ease of operation, and the favorable economics make it profitable to install sulfur-recovery facilities at plants where it is necessary to install hydrogen-sulfide removal units to condition gas for pipeline sale.

Maintenance of Turbocharged Engines Including Large and Medium Sized Units in Gas Transmission, Petrochemical and Gas Processing Plants..60—Pet-31... By James H. Caldwell, Cooper-Bessemer Corporation, Los Angeles, Calif. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

In 1951 the author wrote a book entitled, "Practical Preventive Maintenance for Gas Engines." The purpose was to introduce a maintenance program that used signs and indications for determining engine condition. Most of the signs are observed while the engine is running. Those observations that require the engine to be down can be made with a minimum of disassembly. A program of this type lengthens period be-

tween overhauls, keeps engines on the line, minimizes human error common to needless disassembly, and guards against failures.

The book was general and did not include turbocharged engines. Therefore this paper deals with maintenance of engines employing the turbocharger and centrifugal blower. The theme of the original book is used, but the information in it relative to the fundamental parts (crankshaft, bearings, pistons, and so on) still applies to any modern engine and need not be repeated.

The several variations of turbocharged engines on the market today are separated and treated individually.

With this program, forced interruptions of service are eliminated as well as the back-breaking disassemblies for inspection required with other types of planned maintenance; furthermore, the tests are simple and do not require expensive instruments.

Utilization of Photography in Plant Engineering..60—Pet-32... By R. J. Tiller, Mem. ASME, Monsanto Chemical Company, St. Louis, Mo. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The use of photography by engineers has been reported with increasing frequency in recent years.

The most important and most often reported application of engineering photography has been in photodrawing. Photodrawing is the technique of using photographs with drafting additions to convey engineering information in the same manner and for the same purpose as orthographic engineering drawings are used.

Although convinced of photodrawing advantages, some organizations have been confused as to what procedures to initiate. This discussion seeks to fill that void by providing the information, data, and criteria necessary to judge the value of photodrawing techniques and to make sound plans for the use of this tool. The discussion is limited to the use of photodrawings for the engineering planning of modifications and additions to existing facilities.

Automatic Vapor-Pressure Controller for Optimum Volatile Injection Into Crudge Lines..60—Pet-33... By P. R. Scott, Shell Pipe Line Corporation, Technical Development Laboratory, Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Crude-oil pipelines have been called on to accept an increasing amount of high-vapor-pressure, natural-gasoline-plant products in recent years. Owing to the properties of these products and the physical limitations of crude-oil pipelines these products must be transported as crude-volatile blends. The economic advantage of shipping by pipeline and the increased production of gasoline-plant products have encouraged shipment from the field to more centrally located refineries by existing crude lines.

Vapor-pressure problems, created when high-vapor-pressure natural gasoline-plant products are injected into crude-oil pipelines, are discussed.

The increased vapor pressure of the crude-volatile admixtures has created operating problems, and has caused loss of revenue from vapor loss, boiled tanks, and the necessity to maintain high back pressures to prevent pump cavitation. These problems are eliminated or minimized by precise control of the vapor pressure of the blends. A newly developed vapor-pressure controller continuously samples and maintains the vapor pressure of the blended stream at a predetermined value by controlling the injection rate of the high-vapor-pressure product. Its use allows optimum utilization of crude lines for transporting gasoline-plant products from the field to the refineries. Results obtained from a field and laboratory test program as well as routine operating data are presented in the body of the paper.

Rate Your Supervisor—A Program for Supervisory Self-Development..60—Pet-34... By P. W. Maloney and P. J. Patinka, Esso Research and Engineering Company, Linden, N. J. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The "Rate Your Supervisor" program was developed by the authors' company as a means for providing the individual supervisor of professional technical employees with evaluative data which he might use as a basis for improving his managerial effectiveness.

Although this program has been conducted by Employee Relations, the idea was conceived and received its first development in one of the technical divisions. In 1956 a second-level supervisor of design engineers was holding discussions within his section on the problem of personnel appraisal. It was suggested to him that upward rating might be a technique by which the supervisors in the section could gain valuable appraisal data which might not otherwise be available to them; at the same time, since several raters would be contributing to a composite appraisal, it would be possible to protect the anonymity of any given subordinate.

An explanation of the program is given here, with comments on its success as viewed by those who participated. Some gross analyses have been made of the ratings themselves; preliminary findings from this research are also reported.

Recent Developments in Field Gas-Handling Facilities..60—Pet-36... By William D. Clift, Humble Oil and Refining Company, New Orleans, La.; Roy R. Die, Humble Oil and Refining Company, Corpus Christi, Texas; and Harold R. Galloway, Humble Oil and Refining Company, Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The phenomenal growth of the natural-gas industry during the past 15 years has provided the impetus for the many significant developments that have been made in field gas-handling facilities.

Practically any statistical comparison indicates the natural-gas industry has grown about threefold during this period. Natural gas and gas liquids now supply about 30 per cent of the nation's energy requirements, and it is interesting to note that the energy content of proved gas reserves exceeds that of crude-oil reserves. Consequently, the petroleum industry is acutely aware of the fact that natural gas is a valuable commodity, and production and sales engineers have discovered that they now need to know more about the processes and equipment used in the field to separate, compress, dehydrate, and process natural gas. New equipment and improvements to existing equipment are continuously being made.

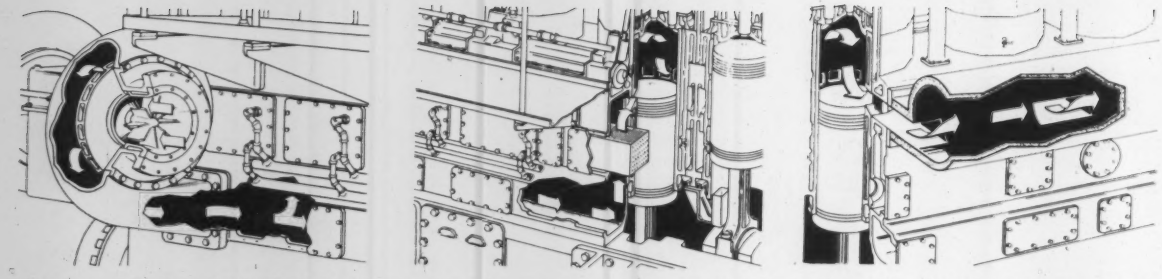
Some of the important recent developments in field gas-handling facilities are listed and discussed, including those pertaining to product recovery, dehydration, compression, and sweetening.

Photography for Plant Maintenance..60—Pet-37... By Clayton B. Hammond, Assoc. Mem. ASME, Monsanto Chemical Company, Springfield, Mass. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The use of photography to replace written instructions and drawings is particularly suited to plant-maintenance applications.

The companies that manufacture photographic equipment and supplies were quick to sense the industrial applications and have developed special equipment and techniques for this use. Some of this equipment is highly specialized, expensive, and requires special skills to operate. This limits its practicality for plant maintenance applications and small plant work.

One development that is finding more frequent applications for this type of work is the Polaroid camera. The techniques of its use are discussed.



Turbocharger: Radial-inflow turbine wheel to expand the hot gases, and a high-head radial outflow centrifugal compressor for scavenging

Economic Development of Prime Movers Using Natural Gas Fuels..60—Pet-39... By Richard F. Moser and Roy M. Greene, Assoc. Mem. ASME, Clark Brothers Company, Olean, N. Y. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Today's modern engines have little in common with engines built 25 years ago. Essentially, today's engines and their predecessors are alike in only one respect —their source of energy. Even in this area, there have been radical changes. Today's fuel-air charge is better shaped, it is more thoroughly and intimately mixed, and is burned at far greater pressures than those of a quarter century ago.

While these advancements have come about through engineering developments, the basic need for these improvements was stimulated by economic factors within our society. Without the engineering achievements of the past 20 years, the cost of prime movers would be several times higher than they are today.

The authors review past and possible future developments in gas engines and gas turbines, and indicate the significance of these developments for the economics of each.

Fuels for Argentina..60—Pet-40... By James T. Cannna, Mem. ASME, The Fish Engineering Corporation, Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The Campo Duran project in Argentina, now nearing completion for Yacimientos Petroliferos Fiscales (YPF), stands out as a major economic undertaking as well as an engineering task without parallel in South America. The combined facilities represent the biggest pipeline effort ever undertaken in South America and probably the largest industrial effort organized in Argentina by an engineering firm. The economic consequences of this phase of the YPF Reactivation Program will be felt by every consumer, both domestic and industrial, throughout Argentina.

The project is unique in that both the 1100-mile 22 and 24-in. gas pipeline and the 900-mile products line have been built together as one project. Supply for both pipelines comes from the prolific Madrejones and Campo Duran fields in Northern Argentina, gathered in a dual pipeline system and processed in a single gasoline plant.

The logistic, engineering, and financing complexities of the Campo Duran project are described.

Modern Developments of Centrifugal Pumps..60—Pet-42... By Carlo Bartolero and Ernest E. Lindros, Mems. ASME, Borg-Warner Corporation, Los Angeles, Calif. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

From pumping water and hydrocarbons over a relatively narrow range of temperatures, the industry is now asked to supply equipment to handle almost every liquid from liquid hydrogen, at minus 420 F and weighing less than 4.4 lb per cu ft, to mercury weighing about 850 lb per cu ft, and liquid metals such as lead, sodium, sodium-potassium, bismuth, and magnesium at temperatures as high as 1500 F.

Nuclear applications have made heavy demands on pump designers' ingenuity. Transfer and circulation of a variety of scarce, costly, and often radioactive liquids (including metals) and slurries at pressures varying from atmospheric to several thousand psi and temperatures often in excess of 1000 F have resulted in a complete new concept in pumps and pump-motor combinations.

Some of the problems presented to the pump industry, and equipment developed for their solution are discussed, including such topics as natural-gas storage, high-pressure boiler plants, pipelines, and mechanical seals for pipelines.

Use of Turbine Type Meters for Pipeline Metering..60—Pet-43... By William W. Holt, Jr., Plantation Pipe Line Company, Atlanta, Ga. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

In order to operate a common-carrier products pipeline efficiently, it is necessary to meter the liquid at all locations involving transfer from one vessel to another and from one custodian to another.

All of this metering, and it must be of the highest possible accuracy, can be readily justified when the value of the product and the daily volumes are considered. Refined petroleum can range from $5 to more than $7 per bbl, and daily volumes of some of the larger carriers exceed 200,000 bbl. For example, if 200,000 bbl of $7 per bbl gasoline were handled with a meter error of 0.10 per cent, there would be a loss of $1,400 to the pipeline if no allowable loss of handling had been established and agreed upon.

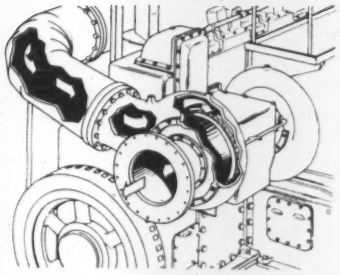
Until recent years the accepted measuring instruments for petroleum were positive-displacement-type meters. This system is satisfactory as long as the number of units is small. The need for larger capacity meters led to the development of the turbine type in sizes suitable for pipeline service. The details of the evolution of this meter and its operation form the context of this paper.

It is concluded that the turbine meter is a satisfactory device for refined-petroleum volume measurement, and that accuracy and repeatability are excellent, but that the same precautions, procedures, and techniques being used for satisfactory positive-displacement-meter operations must be observed.

Noise-Abatement Methods in Meter and Regulator Stations..60—Pet-44... By W. F. Kienast, Houston, Texas, Gas and Oil Corporation, St. Petersburg, Fla. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The basic cause of noise in a meter and regulator station is turbulence of the gas stream. This turbulence cannot be eliminated altogether; however, it may be reduced considerably by proper station design.

A brief description of the various methods, design changes, and innovations used in the field, and the results of each in relation to noise-level reduction



pressure, for a two-cycle engine (60—Pet-39)

are discussed. Included are factors in station layout, and a discussion of the sweep lateral, valve location, regulators and regulator spools, and piping appurtenances. Finally, a summary list of features that have proved successful in the reduction of disagreeable sound is presented.

General Aspects of Offshore Lease Automation..60—Pet-45.. By William J. Rapson, Jr., Assoc. Mem. ASME, Garrett Oil Tools, Division of U. S. Industries, Inc., Longview, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The operation of oil and gas production in offshore areas has always demanded special considerations and techniques. Platform producing stations require substantial capital expenditures in comparison to inland installations. The remote situation imposes high operating costs.

The scope of this study on offshore automatic lease systems does not include a description of systems in detail, but does outline the general aspects in applying these systems. A composite view of the major operators on economic considerations, totally unattended operation, self-contained control, and supervisory control are presented.

The author predicts that the use of automatic lease systems will increase considerably within the next few years, and that the development should somewhat parallel the use of automation techniques on shore and inland.

The Hydraulic Wall-Anchored Drill Collar ..60—Pet-46... By J. M. Kellner and A. P. Roberts, Assoc. Mem. ASME, Jersey Production Research Company, Tulsa, Okla. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

The trend in modern drilling practices is toward higher bit weights. Several research and field studies have shown that this results in higher drilling rates and minimum footage costs. In conventional practice, high weight is obtained with longer and/or larger diameter drill collar strings. This usually results in longer trip time, increased hoisting power demands, and additional pressure losses in the system. Also, high weight cannot be applied when hard rock is encountered at the surface.

To obtain high bit "weight" near the surface and reduce tripping time at depth, the authors have designed a lightweight, high-output force applicator called the "hydraulic wall-anchored drill collar."

It has two applications that may result in economic benefits. The first is in drilling near-surface, hard-rock formations, where limitations of drill-collar length prevent the use of sufficient bit weight. The second is in drilling at depth with high weights, where its use eliminates the purchase, racking, and hoisting of many drill-collar stands. This tool utilizes the pressure drop across a jet bit to apply pressure to one or more hydraulic cylinders, which impose a load on the bit. It is a unique departure from conventional hydraulic "drill collars," in that the up-hole reaction is anchored to the borehole wall, thereby making it a self-contained force applicator.

An analysis is given of the status of development of the tool, and the economics of its operation. The results of shallow-drilling tests show that the tool can supply sufficient bit load without the use of drill collars. These results also indicate that anchoring to the borehole wall is not a serious problem. Reliability and economics will be confirmed by extensive field testing.

Correlation of a New Design Concept for High Horsepower Reciprocating Pumps With Test Results..60—Pet-47... By Fred C. Christ, Assoc. Mem. ASME, BJ Service, Inc., Long Beach, Calif. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

As in many other phases of the oil industry, service companies are continually being required to increase the performance of their pumping units. In particular, oil-well fracturing service demands units that can deliver hydraulic horsepower over a large range of pressures and flow rates. Units must conform to Motor Vehicle Laws and be easily maneuverable on limited access oil well leases. Fluids pumped include corrosive crude oil, acid, and sand slurries.

To obtain a low truck-unit cost, the pump must be compatible with commercially available truck chassis, prime movers, and power train components. Basic studies of reciprocating-pump mechanics culminated in the design of a pump with one half the plunger displacement of contemporary pumps and a capability of 50 per cent greater output.

Three of the $4^1/_2$-in. × 4-in. pumps were manufactured, one for testing on a stationary test stand and two for testing on a mobile truck unit. Tests, described here, have confirmed design objectives and in some phases exceeded the anticipated results.

The design development of this pump was described in a previous paper, "A New Design Concept for High-Horsepower Reciprocating Pumps," by C. H. Rose, ASME paper No. 59—Pet-11.

Radioactive Measurement of Fluid Density..60—Pet-48... By D. G. Hartweg, Dowel Division, The Dow Chemical Company, Tulsa, Okla. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

One of the beneficial results of our wartime development of atomic power has been the subsequent availability of many different types of radioisotopes, at relatively moderate cost. These have been adapted by many industries to improve operations, and the oil industry is no exception. In the specialized field of chemical servicing of oil and gas wells, the use of radioactive isotopes to measure and control the density of cement slurries, sand slurries, and other well-treating materials, has greatly improved job performance and provided better treatment results for well operators.

Many different techniques have been developed for the measurement of fluid densities, each having its own peculiar advantages and limitations, some of which result in erroneous readings.

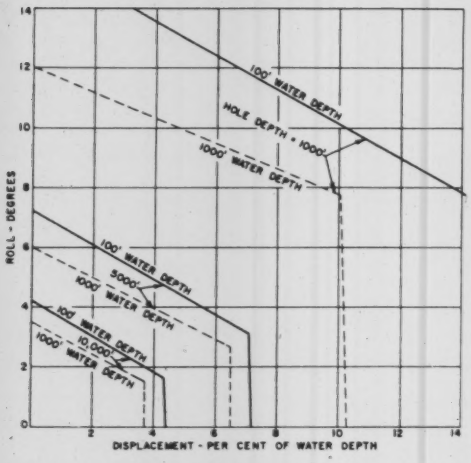
Radioisotope density gaging, in contrast, directly tests the main fluid stream, eliminating any possibility of misleading data. As the fluid being measured flows rapidly through large-diameter pipe, without inside probes or restrictions, there is no danger of particle buildup, which in turn might result in nonrepresentative readings.

The method, which is described, consists of measuring the amount of absorption of gamma radiation by the fluid flowing through a pipe.

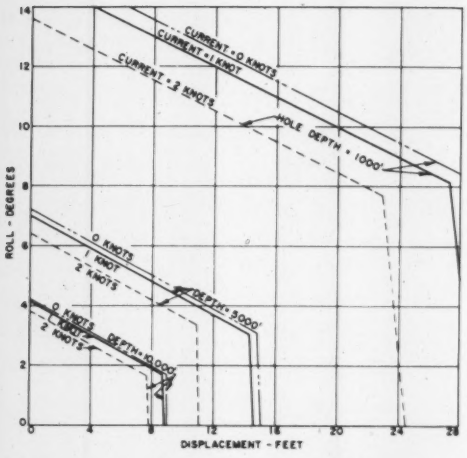
The radioactive densitometer has field-proved its accuracy and effectiveness. As further oil-field uses are developed, this versatile tool promises to be of even greater value to the oil industry.

Pipe Stresses When Drilling From a Floating Vessel..60—Pet-49... By Edward R. Lind, Standard Oil Company of California, San Francisco, Calif. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

An analysis of stresses in drill pipe and casing has been made for the case of drilling from a floating vessel. This



Limits of roll and displacement showing effects of various water depths for various hole depths with water depth equaling 100 ft, and 1000 ft. The current is traveling at 1 knot. The allowable stress is 105,000 psi (60—Pet-49).



Limits of roll and displacement showing effects of various ocean current velocities for various hole depths with current equaling: 0 knots, 1 knot, and 2 knots. Water depth is 200 ft; allowable stress is 105,000 psi (60—Pet-49).

was done as a part of a study of the limitations involved when drilling from the Standard Oil Company of California's coring vessel, the *Western Explorer*.

Formulas have been derived for the bending stresses caused by the vessel being displaced from over the hole, the vessel rolling, and the effect of the ocean-current drag force. The formulas presented cover most conditions of water depths and hole depths expected to be encountered in offshore drilling. The discussion mainly is concerned with the case of deep holes. Extensive experience has been obtained for the case of shallow holes during the past several years while core drilling off the Coast of California. The total stress increases with hole depth.

Basic equations are given that can be modified as required for various methods of operation. For this paper, a gimbal-mounted rotary table is assumed. Corrections are included for this type of mounting at the vessel.

The following stresses encountered in oil-well drilling are considered:

1 Axial tensile stress due to the weight of the tubing.

2 Shear stress due to the rotation when drilling.

3 Stress due to internal fluid pressure.

When drilling from a floating vessel, the following bending stresses, which are also discussed, are encountered:

1 Bending stress due to the vessel being displaced from over the hole.

2 Bending stress due to the vessel roll.

3 Bending stress due to the ocean current drag force.

ASME TRANSACTIONS

The November, 1960, issues of the Transactions of the ASME—*Journal of Engineering for Industry* and *Journal of Heat Transfer* (available at $1.50 per copy to ASME Members, $3 to nonmembers) contain the following:

Journal of
ENGINEERING FOR INDUSTRY
Volume 82 · Series B · Number 4

283 Tensile and Short-Time Creep Properties of N-155 Alloy Sheet, by E. C. Bernett. (59—A-27)

303 A Photoelastic Analysis of Machining Stresses, by E. Usui and H. Takeyama. (59—A-37)

309 Correlation of Bendability of Materials With Their Tensile Properties, by J. Datsko and C. T. Yang. (59—A-110)

315 Comparisons Between the Shearing Properties of Alpha-Brass as Derived From the Cutting Process and From Static and Impact Torsion Tests, by S. S. Chang and W. B. Heginbotham. (59—A-38)

324 The Role of Friction in Metal Cutting, by S. Kobayashi and E. G. Thomsen. (59—A-132)

333 A Critical Comparison of Metal-Cutting Theories With New Experimental Data, by S. Kobayashi, R. P. Herzog, D. M. Eggleston, and E. G. Thomsen. (59—A-131)

348 New Developments in the Theory of the Metal-Cutting Process, Part I, by P. Albrecht. (59—A-243)

359 Structural Weight Approximation for a Bell-Nozzle Divergent Section, by G. D. Brewer and E. Levin. (59—A-69)

363 Optimum Tolerances of Sheet Materials for Flight Vehicles, by G. A. Hoffman. (59—A-70)

369 Mechanical Vibration Filters With Nonlinear Characteristics, by W. J. Worley. (59—A-42)

377 Refinement of Finite Difference Calculations in Kinematic Analysis, by B. W. Shaffer and I. Krause. (59—A-53)

382 The Measurement of Very Low Frictional Torques in Rotating Equipment, by M. Zaid and I. S. Tolins. (59—A-43)

387 Design by Quantitative Factor of Safety, by Hsuan-Loh Su. (59—A-48)

393 Study of Critical Velocity of Stick-Slip Sliding, by B. R. Singh. (59—A-146)

399 Inertial Effects in a Multiple-Ball Transmission, by W. S. Rouverol. (59—A-14)

407 Some Applications of the Cycloid in Machine Design, by E. P. Pollitt. (59—A-134)

415 A Discussion of the Vibration Characteristics of a Simple Mechanical Connection, by Arthur Sorensen, Jr. (59—A-41)

423 Deformation and Moments in Elastically Restrained Circular Plates Under Arbitrary Load or Linear Thermal Gradient, by M. Zaid and M. Forray. (59—A-39)

439 Dimensionless Parameters for Helical Compression Springs, by R. J. Erisman. (59—A-30)

444 Errata on previously published paper by R. C. Brewer.

Availability List of Unpublished ASME Papers

A NUMBER of papers and reports, not preprinted or published, were presented at ASME Meetings. Manuscript copies of these papers are on file for reference purposes in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y. Photostatic copies of these unpublished papers may be secured from the Library at the rate of 50 cents per page. Microfilm copies are available at a cost of $2 for 40 pages or less.

The following papers recently have been placed on file in the Engineering Societies Library:

1959 Annual Meeting
Mechanical Engineering in the Future, by R. S. Sherwood

1960 Maintenance and Plant Engineering Conference
The Use of Wear Resistant Materials for Equipment Maintenance, by R. P. Culbertson

1960 Production Engineering Conference
Total Productivity; Motivation and Calibration, by J. G. Surmacz

1960 Design Engineering Conference
Computers in Design, by E. F. Magnusson
Integration of a Computing Facility in an Engineering Organization, by G. F. Ryckman

1960 Aviation Conference
Design Considerations for a High Temperature Rate Gyroscope, by P. J. Pijoan
On Eddy Current Damping for Miniature Oscillating Devices, by R. M. Harrod

1960 Semi-Annual Meeting
Status of Saline Water Conversion and Its Economic Importance, by S. T. Powell and E. L. Knoedler

1960 ASME-AIEE Power Conference
Electric Generating Stations of Public Service, by R. A. Baker

1960 Rubber and Plastics Conference
Expandable Structures for Space, by J. T. Harris

1960 ASME-AIME Fuels Conference
What the Industrial Consumer Looks for in Purchasing Coal, by D. M. Given
The Supplier's Viewpoint in Selling Coal, by C. R. Mabley, Jr.

Journal of
HEAT TRANSFER
Vol. 82 · Series C · No. 4

265 A Variable Density Single-Fluid Model for Two-Phase Flow With Particular Reference to Steam Water Flow, by S. G. Bankoff. (59—HT-7)

273 Transient Temperatures and Thermal Stresses in Hollow Cylinders Due to Heat Generation, by John E. Schmidt and George Sonnemann. (59—A-144)

279 Thermal-Contact Resistance in Finned Tubing, by Karl A. Gardner and T. C. Carnavos. (59—A-135)

294 Mass Transfer, Flow, and Heat Transfer About a Rotating Disk, by E. M. Sparrow and J. L. Gregg. (59—A-107)

303 Heat Transfer and Effectiveness for a Turbulent Boundary Layer With Tangential Fluid Injection, by R. A. Seban. (59—A-177)

313 Sublimation Mass Transfer Through Compressible Boundary Layers on a Flat Plate, by T. K. Sherwood and Olev Trass. (59—A-137)

325 Laminar Skin Fraction and Heat Transfer on Flat Plates With Wedge-Shaped Grooves in Flow Direction, by T. F. Irvine, Jr., and E. R. G. Eckert. (59—A-143)

333 Heat Transfer to Liquid Metals With Variable Properties, by R. Viskanta and Y. S. Touloukian. (59—A-148)

341 A Summary of Experiments on Turbulent Heat Transfer From a Nonisothermal Flat Plate by W. C. Reynolds, W. M. Kays, and S. J. Kline. (59—A-157)

349 An Experimental Study of the Effects of Nonuniform Wall Temperature on Heat Transfer in Laminar and Turbulent Axisymmetric Flow Along a Cylinder, by R. Eichhorn, E. R. G. Eckert, and A. D. Anderson. (59—A-151)

360 Geometric Factors for Radiative Heat Transfer Through an Absorbing Medium in Cartesian Coordinates, by A. K. Oppenheim and J. T. Bevans. (59—A-206)

369 Thermal Radiation From a Cylindrical Enclosure With Specified Wall Heat Flux, by C. M. Usiskin and R. Siegel. (59—A-159)

375 Application of Variational Methods to Radiation Heat-Transfer Calculations, by E. M. Sparrow, (59—A-120)

381 Certain Thermodynamic and Transport Properties of the Atmospheres of Venus, Mars, and Jupiter, by W. E. Ibele and T. F. Irvine, Jr. (59—A-102)

TECHNICAL BRIEFS

387 Heat Transfer to Boiling Mercury, by F. E. Romie, S. W. Brovarney, and W. H. Giedt.

389 Temperature Distribution and Heat-Transfer Results for an Internally Cooled, Heat-Generating Solid, by E. M. Sparrow.

392 Effects of Initial Boundary-Layer Thickness on a Tangential Injection System, by R. A. Seban.

393 The Mechanism of Sound Field Effects on Heat Transfer, by J. P. Holman.

396 A Transducer for the Measurement of Heat-Flow Rate, by Robert Gardon.

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Note: No digests are made of ASME papers published in full or condensed form in MECHANICAL ENGINEERING.

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60—Lub-2	60—RP-20	60—Pet-31
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COMMENTS ON PAPERS

Design and Construction Engineers Span Canyon Between Abstract Theory and Concrete Reality

To the Editor:

THEY are the people who make it possible to span the vast canyon between the abstract theory of the doctors of science and the concrete reality of the finished product.

The heartaches, the failures, the seemingly insurmountable problems that confront these men as they drive themselves to the point of collapse is unbelievable! But as the old saying goes, "If you want a road to Jupiter or a ten-foot shaft to Hell, just bring it around to the engineer and he will do it well."

The creative spirit and ability of these engineers are amazing. When we look about us and see the oil refineries, chemical plants, electric-power plants, and power lines strung all over the world, jet airliners, ocean-going steamships, railroads, turnpikes, automobiles, skyscrapers, rockets to the moon, satellites around the earth, and many, many others, we find ourselves gazing in wonder and satisfaction at a work well done!

All of this was but a dream, an idea in some human being's mind—a thought or school of thoughts so abstract that the person to whom they came probably said, "How in the world can this be brought into reality so it can be used?" The gap or canyon between the idea and the finished product is vast. The building of this bridge is a heartbreaker. Many good engineers have fallen under the burden of seemingly impossible problems.

The first one that hits him hard is the one of trying to understand the theory and desires of the process engineer and/or the doctors of science. Each is so brilliant—he sees the final product so easily, there's nothing to making it. He has already conceived in his mind how simple it will be to make the product. Hasn't he done it in the laboratory with his test tubes and equipment? Why can't this design engineer understand it and get it built so the product can be obtained? The design engineer asks himself, "What is wrong with this man, can't he get his head out of the clouds? Why doesn't he come down to earth and get his feet on the ground so we can start designing and building the equipment required to make the product?" Finally they begin to understand each other. The doctor begins to see the distance between image and reality. The design-construction engineer begins to grasp the magnitude of the idea and what he thinks and knows will be required physically to obtain the product. They set to work patiently at first realizing the vast canyon they must bridge. As time goes on, they find they must junk many plans and start all over—such is the way of the human mind. The times of impatience come when each thinks the other has lost his mind and all intelligence. This is because the end result is not apparent. The final answer is still evading them. Time is rolling by. Competition is getting ahead. Money is being lost. Management is getting impatient. The pressure is on. The bridge is quite a ways from completion. Here is where the design and/or construction engineer is at his extremity. Here is where the heartbreaks come! Is he doomed to failure? Has his competitor beaten him to the answer and the final product? Such is the life of the design and/or construction engineer.

But seldom does he break and fall under the heavy load. There is a bull-dog determination deep inside that keeps him going, keeps him holding on. He knows he can do it! He knows there is an answer! He has been trained to build anything that a doctor of science can dream up. Finally the answers come through—he finishes the bridge—the finished product is made and the canyon separating it and the abstract ideas of the PhD have been resolved through wisdom and understanding and he has at last designed and built the necessary machinery and equipment. He has harnessed the electric power, the steam power, the gas, water, air, and all the materials such as petroleum, coal, atomic energy, and the ores from the earth to make the finished product for his and his fellowman's use. What a satisfaction! These are the engineers who make our present way of life possible. It is a hard, rugged road they travel through life, but theirs is the happy satisfaction of knowing that without them the bridge could never be built!

P. A. Johnson.[1]

Correction

IN Paper No. 60—WA-156, "System Expansion—Fuel Costs Versus Capital Charges," by W. J. Fahrner and C. M. Heidel, published in the November, 1960, issue of MECHANICAL ENGINEERING, pp. 64–67, the caption for Fig. 1, line 5 should read "per cent of system peak" rather than "per cent of system net winter capability."

The same error occurs in line six of paragraph two under the heading "Fuel-Cost Program," p. 65.

[1] N. Tarryton, N. Y.

Notes on Books Received in Engineering Societies Library

REVIEWS OF BOOKS

Classics in Management—Fundamental Goals Haven't Changed

Classics in Management

Edited by Harwood F. Merrill; Foreword by L. A. Appley. American Management Association, New York, N. Y., 1960. Cloth, 6 × 9 in., bibliography, 446 pp., $9.

Reviewed by J. A. Willard[1]

TO ALL those interested in management this book should come as a handy source of reference—a chance to get back to fundamentals. It presents an opportunity to check your own programs with those that were determined to be essential by professional managers 40 to 50 years ago. The fundamental goals haven't changed.

The selection of the material to be included and the material to be left out must have been a Herculean task. I do not envy the editor his job.

A really good review should have something to say, either commendably or otherwise, about each section of a book. In a volume composed of partially unrelated material which obviously cannot be arranged in any way but a time sequence, it would be well nigh impossible to do this within the limits of the space available. Hence I believe I can cover all the material by quoting Captain Henry Metcalfe (page 51): "I think it will be acknowledged that it (our order system) must have had considerable vitality to have endured so well my early removal from its charge. I am fain to believe that it was because it *met a real want* . . ." Emphatically, all the sections meet "a real want."

It has been the writer's privilege since 1921 to have worked in the field of professional management. This has given him the opportunity to know a substantial number of the leaders in the profession as well as in business. A goodly number of those authors included in the book (since 1920) were close friends.

The leaders can be generally divided into two classes. Those who were or are practitioners or "doers" and those practitioners who are not only "doers" but also have a flair for writing. Let us be thankful for both kinds.

It is hoped the reference in this volume to Wallace Clark's "Gantt Chart" will lead many to look up Clark's books and study them. They truly reflect his ability and solid worth.

In connection with Mr. Gantt, if one's time is limited—and whose time isn't?—it might be worth while to try to find a copy of his "Industrial Leadership," a thin volume published in 1916 by the Yale University Press of New Haven, Conn. This small book contains the concise lectures given by Mr. Gantt at Yale. Though brief, they present a complete prescription for the management of any business enterprise. Not all the principles have been applied throughout industry to the extent they should be, but the rediscovery of the remaining few not in general use is bound to occur because they are fundamental in their application.

Such delays in recognition of basic principles have been common. For instance, the principles of job classification and merit rating were described as early as 1910–1915, but their adoption did not come about until the middle thirties.

Another example of delayed application of a basic principle is the case of "Management and the Optimum" by Harry Arthur Hopf. As mentioned in the editor's comments, the lack of electronic, statistical, and data-processing equipment required to reach conclusions within a reasonable cost has delayed use of this idea until the past three or four years. The trade name for the principle is Operations Research.

If the editor had left Mary Parker Follett out of the book, many of his friends would have been offended. She ably filled an important niche in management thinking.

Notwithstanding the excellence of the selections presented, it is the easiest thing in the world to mention a few which may have equally deserved inclusion.

G. Charter Harrison's "Cost Accounting to Aid Production" is one. Published by the Engineering Magazine Company in 1921, this book started standard costs on their road to adoption by many. Here is a study comparable to Wallace Clark's work on the Gantt Chart. It is almost impossible to select a good abstract to represent its great coverage and technical detail. Standard costs, and their more modern variation, direct costs, still remain unadopted to the extent they deserve. Far too many managers appear to like to "fly by the seat of their pants."

Charles E. Knoeppel's "Profit Engineering," McGraw-Hill, 1933, is another book that might well have been included, even though people who studied under Dr. Rautenstrauch are firm in their conviction that he is the father of the "break-even" chart. In my long years of acquaintance with Knoeppel I knew of his initial work in this field as early as 1918. He called his chart a "Profitgraph."

It should be observed also that none of the authors included in these "classics" were primarily teachers. I believe that when a second volume of abstracts of selected, noteworthy books on management is published it will include a substantial number of authors from the teaching field. These men are doing an

[1] Principal, Bigelow, Kent, Willard & Company, Division of H. B. Maynard and Company, Inc., Boston, Mass. Fellow ASME.

excellent job of presenting an up-to-date panorama of policy guidance as well as technical tools in the management field.

A debt is owed to the American Management Association for its sponsorship of this volume. And I am sure the Association is more than aware of the debt it owes to leaders in the field like Leon P. Alford, Alvin Dodd, and Clarence E. Davies, who did so much for the American Management Association in its early and formative years.

BOOKS RECEIVED IN LIBRARY

Molecular Structure

By J. C. D. Brand and J. C. Speakman. 1960, St. Martin's Press, Inc., New York, N. Y. 300 p., 6 × 9¼ in., bound. $8. This general account of the application of physical methods to the analysis of molecular structure, written for the graduate and research levels, emphasizes principles rather than practice. It includes discussions of symmetry, elementary wave mechanics, rotation and vibration of molecules, nuclear resonance spectra, crystal-structure analysis, and electron diffraction.

The New Product

By Delmar W. Karger. 1960, The Industrial Press, New York, N. Y. 234 p., 6¼ × 9¼ in., bound. $5. This guide to successful product development is presented from the point of view of general management. The basic concepts of top-management planning and organization for product planning and new product development are covered, as well as each major area of the business enterprise concerned with the successful development and marketing of a new product. Includes chapters on sources of new ideas, pricing, patenting, costing, and sales and advertising methods.

Operations Research and Systems Engineering

Edited by Charles D. Flagle and others. 1960, The Johns Hopkins Press, Baltimore, Md. 889 p., 6¼ × 9¼ in., bound. $14.50. Lectures by authors from the fields of physics, economics, statistics, psychology, engineering, and mathematics for a course for management at Johns Hopkins. Discussed are the philosophical and historical aspects of systems engineering and operations research, and specific methodologies such as statistical quality control, linear programming, the theory of games, information theory, and feedback. Case histories involving war games, a hospital, newspaper operations, and a telephone company conclude the volume.

Ortsfeste Dieselmotoren und Schiffsdieselmotoren

By F. Mayr. Third Edition. 1960, Springer-Verlag, Vienna, Austria. 471 p., 8 × 11 in., bound. $32.55. The new edition of this extensive German study on stationary and marine diesel engines retains the detailed treatment of component parts, the descriptions of currently available engines, etc., of the previous editions. There are new chapters on supercharged 4-stroke engines and on the supercharging of 2-stroke engines. Attention also is paid to the increasing importance of heavy oil engines and of the diesel gas system as well as to the ever-growing request for ready reference formulas.

Petroleum Geology

By Kenneth K. Landes. Second Edition. 1959, John Wiley & Sons, Inc., New York, N. Y. 443 p., 6 × 9¼ in., bound. $9.50. The first four chapters of this almost entirely rewritten edition discuss the background of professional petroleum geology, the petroleum geologist's techniques of exploration, and subsurface and production geology. The remaining and largest part of the book is concerned with the geologic occurrence of petroleum, its origin, migration, and accumulation. A literature survey is included, but world statistics on field locations and future oil supplies have been eliminated for publication as a separate volume.

Petroleum Reservoir Engineering

By James W. Amyx, and others. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 610 p., 6¼ × 9¼ in., bound. $17.50. Treats the fundamentals and mechanics of engineering analyses of petroleum reservoirs. Introductory discussion of hydrocarbon accumulation, oil-field development, and production methods, is followed by detail consideration of the properties of fluid permeated rocks, hydrocarbon and reservoir fluids, and water. Finally, the evaluation of rock and fluid properties from both laboratory and field data is described, and the derivation and applications of the material balance in estimation of the initial hydrocarbons in place in the reservoir are shown.

Photochemistry in the Liquid and Solid States

Edited by Farrington Daniels. 1960, John Wiley & Sons, Inc., New York, N. Y. 174 p., 8½ × 11¼ in., bound. $6. This book is based on a symposium sponsored by the National Academy of Sciences and the National Research Council. The papers present the basic principles of photochemistry storage, survey the field of photochemical reactions, and state the requirements for reaction types which might be useful in storing solar energy. Basic research findings and areas for future research in the field are described.

Physics and Medicine of the Atmosphere and Space

Edited by Otis O. Benson, Jr., and Hubertus Strughold. 1960, John Wiley & Sons, Inc., New York, N. Y. 645 p., 6 × 9¼ in., bound. $12.50. Forty-two papers which constitute the record of the Second International Symposium on the Physics and Medicine of the Atmosphere and Space (1958). Greatest attention is given the depiction of the environmental factors within the atmosphere and the gravitational, magnetic, and radiational fields, and their effect on man. Other subjects discussed are the natural radiations of space and laboratory simulation, vehicles for space exploration, weightlessness, and escape relevant to space flight.

Propulsion Systems for Space Flight

By William R. Corliss. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 300 p., 6¼ × 9¼ in., bound. $10. This is a survey of known schemes for powering space transportation, from turbojets to photon propulsion, emphasizing the more advanced space engines, the nuclear and electrical propulsion systems. Other systems discussed include thermal and natural force field, and considerable attention is given to a physical description of the environment of space, and to power requirements and generation in space.

Radargrammetry

Edited by Daniel Levine. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 6¼ × 9¼ in., bound. $12. Emphasizing airborne applications, this text analyzes sources of error found in the real radar display and outlines a unified system design for keeping individual errors within bounds to meet an over-all system performance. Radar display is correlated with map projections in navigation, air-traffic control, weather surveillance, missile guidance plotting boards, and other applications, using cartographic principles. Other topics covered include image-motion compensation, antenna stabilization, the Schade theory of linear apertures for optical systems, and Swerling's analysis of angular accuracy of a pulsed radar system.

Radiation Pyrometry and Its Underlying Principles of Radiant Heat Transfer

By Thomas R. Harrison. 1960, John Wiley & Sons, Inc., New York, N. Y. 234 p., 6¼ × 9¼ in., bound. $12. The first three chapters discuss the principles of the emission, absorption, reflection, and transmission of thermal radiation, excluding aspects not particularly applicable in pyrometry. The characteristics of high and low-temperature radiation pyrometers then are dealt with, including calibration, lenses, mirror design, field of view, and ambient temperature-variation effects and compensations. The application of emittance corrections then are described, and the final chapter contains tables, such as of relevant mathematical relationships, calibrations, optical characteristics of some substances, and radiation functions.

Structural Mechanics

By Samuel T. Carpenter. 1960, John Wiley & Sons, Inc., New York, N. Y. 538 p., 6 × 9½ in., bound. $9.50. This book presents fundamental principles, emphasizing the mathematical treatment of structural theory bearing on indeterminate structures. It introduces advanced strength-of-materials topics such as finite difference approximations, Fourier series, and structural dynamics and stability, and includes consideration of beam columns, moment distribution for axially loaded members, and numerical method for deflections and buckling. Intended primarily as an undergraduate text, but designed also to be of use for more advanced study.

Viscoelasticity

Edited by J. T. Bergen. 1960, Academic Press, Inc., New York, N. Y. 150 p., 6¼ ×

$9^1/_4$ in., bound. $6. This volume contains the seven papers presented at a 1958 symposium sponsored by The Armstrong Cork Company. Two different linear viscoelastic theories are developed in the first two papers, followed by a report of the results of experiments which evaluate the linear viscoelastic parameters of typical polymeric materials. Chapters four and five deal with the development of nonlinear stress-strain-time relations for viscoelastic materials, and the final two chapters present experimental observations of real materials which exhibit nonlinear, time-dependent stress-strain behavior.

Die Walzen von Hohlkörpern

By Paul Grüner. 1959, Springer-Verlag, Berlin, Germany. 301 p., $6^1/_2 \times 9^1/_4$ in., bound. DM 52.50. A comprehensive treatise on the rolling of seamless tubes covering the design of the equipment, operating methods, causes of errors, etc. Special aspects treated in detail include tube-reducing mills, straightening rolls, the stressed state in diagonally rolled pieces, and a mathematical analysis of the various processes and their effect on the workpiece.

Windscale

By Stuart Sinclair. 1960, George Newnes, Ltd., London, England. 136 p., 6 × 9 in., bound. 25s. Intended mainly for civil engineers, this book provides a background for all who are interested in nuclear power-station engineering and construction by describing the building of the Windscale Works in England. The choice and preparation of a site, and the construction of the pile chimneys and of the effluent pipelines is related. The author then describes the remedial operation for the biological shields of the piles, and the problem of supplying supplementary cooling air to the piles, and finally recounts some of the day-to-day maintenance problems of the reactors.

Aerospace Dictionary

By Frank Gaynor. 1960, Philosophical Library, New York, N. Y. 260 p., $6^1/_4 \times 9^1/_4$ in., bound. $6. This dictionary lists 25 sources, ranging from "Popular Mechanics Press" to the U. S. Atomic Energy Commission, and publications of the years 1956–1959. The terms and phrases defined include abbreviations, astronautical and astrophysical terms, recognized designations for types of equipment, material, methods, personnel, and organizations. Slang and colloquial terms such as "buzz bomb" and "hot" (for radioactive), nicknames given to space projects ("Mrs. V" and "Able and Baker"), and space vehicles ("Explorer," "Sputnik") are included and so categorized. The definitions are terse and simplified, giving little more than identification in most cases. Inversion is not used, phrases being alphabetized as spoken, as "liquid oxygen explosive," listed under "L."

Aero-Thermodynamics and Flow in Turbomachines

By M. H. Vavra. 1960, John Wiley & Sons, Inc., New York, N. Y. 609 p., $6 \times 9^1/_4$ in., bound. $14.50. In part 1 the fundamental relations for the analysis of arbitrary flows are derived from the general principles of fluid mechanics and thermodynamics applicable to the flow of any compressible media. This derivation employs vector and dyadic analysis, the elements of which are summarized in appendixes A and B. Part 2 treats flows which are idealized either with respect to the properties of the fluids or the thermodynamics process they undergo. Part 3 discusses flows in turbomachines, wherein the concepts of parts 1 and 2 are affected by the primary function of turbomachines, which is to change the energy level of fluids, and because the members guiding the flow in turbomachines are surfaces of revolution.

LIBRARY SERVICES

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASME members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

The Chemistry of Propellants

Edited by S. S. Penner and J. Ducarme. Published 1960 for The Advisory Group for Aeronautical Research and Development by Pergamon Press, New York, N. Y. 651 p., $6^1/_4 \times 10$ in., bound. $10. The topics covered by papers in this volume include propellant sources and costs, liquid propellants, solid propellants, propellants for air-breathing engines, and basic studies on reactions during nozzle flow and jet-engine deposits. High-energy propellants and basic propulsion problems are presented and discussed in five papers given at round-table discussions. Papers are in French or English; some have extensive bibliographies.

Control Systems Engineering

Edited by William W. Seifert and Carl W. Steeg, Jr., 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 964 p., $7^1/_2 \times 10^1/_4$ in., bound. $15. The specialized backgrounds of 11 authorities have been integrated into this single concise volume covering the mathematical aspects of control-systems engineering as applied to the study of complex large-scale automatic control systems. The role of mathematical models is indicated, and there is thorough coverage of modern theory from the trial-and-error procedures used in the design of linear systems to the application of game theory in the synthesis of complex systems. The background material on feedback theory, matrix methods, statistical theory, systems analyses, time-domain synthesis, sampled-data systems, etc., is directed toward the control engineer who wishes to use mathematics in his procedures.

Dictionary of Nuclear Physics

Edited by Hans Rau. 1957, W. S. Heinman Imported Books, New York, N. Y. 247 p., $4^3/_4 \times 6^1/_2$ in., bound. $5. Five thousand English-German and German-English terms each, used in uranium mining, reactor building, nuclear fission and fusion, isotope research, and in other fields of nuclear physics. Particular consideration has been given to nuclear physical symbols and abbreviations of which more than 600 are included.

Digital Computer Principles

By Wayne C. Irwin. 1960, D. Van Nostrand Company, Inc., Princeton, N. J. 321 p., $6^1/_4 \times {}^1/_4$ in., bound. $8. An introduction for the interested layman, not requiring a background in electronics or mathematics. The emphasis throughout is on principles, illustrated with examples of circuits, devices, and systems familiar to the author but not otherwise unique. The book moves from consideration of details, the basic elements and components, to general description and synthesis of total systems. Symbolic logic is given more emphasis than other subjects, due to the fundamental influence of logic in the behavior of the digital computer.

The Dynamic Behavior of Thermoelectric Devices

By Paul E. Gray. 1960, John Wiley & Sons, Inc., New York, N. Y. 136 p., $6 \times 9^1/_4$ in., bound. $3.50. This is the report of a study of the dynamic behavior of thermoelectric heat pumps and generators, made by means of a small-signal analysis of linear models. This analysis produces small-signal transfer functions that can be used to compute the response of devices in the frequency domain or in the time domain. Here, the small-signal analysis for the heat pump and for the thermoelectric generator and measurement of the small-signal response of a heat pump are described. There is also a chapter examining the modification of the heat-pump analysis to include a temperature-dependent resistivity.

Effective Report Writing

By Norman B. Sigband. 1960, Harper & Brothers, New York, N. Y. 688 p., $5^3/_4 \times 8^1/_2$ in., bound. $6.75. Designed to serve as a text in communication courses or as a guide for professional personnel in business, government, and industry. For the inexperienced there are chapters on writing style, the organization and analysis of data using both primary and secondary sources, and the actual construction of the report. For advanced students there are descriptions and examples of reports in various specialized areas, such as accounting, engineering, and government. Oral reports and letters of application also are described, and there is a detailed section on business-letter writing.

Frozen Free Radicals

By G. J. Minkoff. 1959, Interscience Publishers, New York, N. Y. 148 p., $6^1/_4 \times 9^1/_4$ in., bound. $5. The purpose of this monograph is to present the basic features of the technique of freezing or isolating free radicals, particularly at very low temperatures, brought out by recent work as well as by the researches of the past. Introductory chapters trace early history and development, give the basic principles of trapping, and describe experimental methods of production and detection of radicals and the design and construction of low-temperature equipment. The final chapters present a literature review of studies of individual atoms, and of diatomic, triatomic, and polyatomic radicals. The information given has application in such fields as combustion, low-temperature research, and high-energy fuels for rocket propulsion.

High Speed Testing, Vol. 1

Published 1960 by Interscience Publishers, New York, N. Y. 112 p., $6^1/_4 \times 9^1/_4$ in., bound. $5. Papers presented at a 1958 symposium (the first of a projected series) held in Boston in the effects of rate of loading on the mechanical properties of materials. Two papers deal with plastics, one with solid fuels, one with package cushioning materials, two with textiles, and two with metals. They cover instrumentation, equipment, methods and techniques, interpretation of data, and application of information received from high-speed tests for these materials.

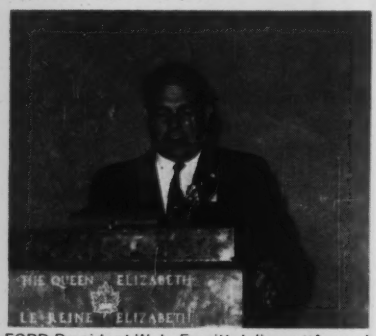
Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Twenty-Eighth Annual Meeting of ECPD Discusses Its Policy: Its Influence and Responsibility in Molding Future Engineers

Colonel L. F. Grant of Kingston, Ont., Canada, a former president of ECPD and of the EIC, addresses ECPD banquet



ECPD President W. L. Everitt delivers "Annual Report to ECPD" at luncheon

Dr. Leon Lortie, head of the Extension Department at University of Montreal, addresses an ECPD luncheon meeting

For two days, Oct. 3–4, 1960, approximately two hundred persons exhibited profound concern about the function and scope of the Engineers' Council for Professional Development in the realm of engineering education. In some of the most significant sessions of recent years representatives from both the United States and Canada participated in committee considerations, general discussions, as well as luncheon and banquet activities. During all of these events, the central theme was, in essence, an attempt at constructive analysis of the efforts of ECPD in the past and an estimation of goals to be reached by that organization in the immediate future.

One positive measure of the effectiveness of any group of volunteers is the number and quality of individuals it attracts to serve on its various committees. Evidence that ECPD has a distinct appeal was conclusively illustrated by the spirited meetings of these groups in the opening hours of the first day, followed by reports of chairmen of these bodies at a general period in the afternoon. In a room crowded to the doors with members of the Guidance Committee and State chairmen who provide leadership of this important facet of the Council's concern, the deliberations were spearheaded by Chairman Frederick J. Jeffers, Mem. ASME. In adjacent space, the Student Development Committee under the Chairmanship of William T. Alexander, Mem. ASME, Dean of Engineering at Northeastern University and long active in ASME affairs in the Boston area, considered with his confreres the need for initiating a broad-based campaign aimed to improve the professional consciousness of undergraduate engineering students.

At another well-attended conclave, Chairman John Gammell, Affiliate ASME, guided the reflections of the newly named Committee on the Development of Young Engineers, formerly the Training Committee. His committeemen are primarily concerned with "The First Five Years," the critical period for the engineering graduate as he seeks to establish a beach head for a career in his chosen profession. To add to the already well-accepted materials composing the "First Five Years Kit," a brochure just off the press was announced as an aid to the young person looking for an opportunity for community service—"Citizenship and Participation in Public Affairs." This pamphlet was produced by ECPD in cooperation with the Civic Affairs Committee of ASME and utilizes much of the written works of former ASME President Roy V. Wright as source material.

At two other Committee Meetings—Ethics and Recognition—there were significant discussions of important topics. The former is considering the compilation of case histories which could serve as a form of "guide posts to ethical conduct." The latter hopes to have ready at an early date a final report of a prolonged study of two important phases of the subject of proper recognition of the place of the engineer in society—one, an adequate definition of "engineering" and the other, an appropriate appelation for an "engineer."

At the luncheon Monday, Alan Jarvis, Editor of *Canadian Art*, propounded in inimitable fashion his understanding of the ever-increasing demand of a bosom companionship of art and engineering in the world of tomorrow.

The speaker at the banquet was former ECPD President Col. L. F. Grant whose reminiscences emphasized the many values received by Canadian educational institutions and industrial organizations as a consequence of the long association of the Engineering Institute of Canada as a constituent body of ECPD.

On the second day of activity, such topics as the following were considered under the main theme, ECPD Policy—The Influence and Responsibility in Molding Future Engineers:

1 Additional Criteria: Have We the Right Balance Between Theory and

Practice? Presentations by Dale R. Corson, dean, College of Engineering, Cornell University, and Newman A. Hall, Mem. ASME, head, Department of Mechanical Engineering, Yale University, and vice-chairman, Education and Accreditation Committee of ECPD.

2 The Council's Influence on Quality of Future Engineers: Presentations by Ralph A. Morgen, vice-president, ECPD, and president, Rose Polytechnic Institute.

3 Are We Meeting Our Responsibilities in Training Noncitizen Engineers for Less Industrialized Areas of the World? Presentation by Kurt F. Wendt, dean, College of Engineering, University of Wisconsin.

At the closing session on Tuesday, Dean Alexander moderated a discussion entitled, "Marking the Milestone": Ritual for Transition from College to In-Training. Impressive contributions to these deliberations were added by Col. L. F. Grant who referred to the tradition-steeped Iron Ring Ceremony and by President Robert W. Van Houten of Newark College of Engineering who detailed the ritual of dedication now considered an integral part of the graduation exercises for those completing requirements for their engineering degrees.

Of equal moment were two other topics which were presented. John Gammell, director of Graduate Training, Allis-Chalmer Manufacturing Company, spoke on the subject of Developing the Young Engineer: New Patterns for the Industry Phase, and Stanley M. Little, director of Industrial Relations, Aero Space Division, Boeing Airplane Company, directed his remarks to the theme How Is the New Science-Oriented Engineering Graduate Fitting Into Industry?

As the afternoon session was completed, there was a concert of approbation from those attending this annual meeting of ECPD. The program was judged to have established a new high for excellence, comparable to the unique standards upon which foundation the Engineers' Council for Professional Development has built a structure, so that with every passing year, it continues to serve as a steadfast influence in that broad gamut often termed the area of engineering education. The reader of this report should known more of the great work of ECPD—won't you write to ASME Headquarters, procure a copy of the 28th Annual Report of ECPD, and tell your immediate world of friends what you have learned and what they should know.

UET 1959-1960 Report Highlights United Engineering Center Progress

The United Engineering Trustees, Inc., recently released its annual report of the fifty-sixth year, 1959–1960, of its operation. The report was issued by UET President Andrew Fletcher to the Board of Trustees and the Founder Societies.

The following excerpts are from his report:

General. United Engineering Trustees, Inc., spans five areas of activity: Real-estate operations (Engineering Societies Building and the United Engineering Center now under construction), The Engineering Foundation, as an engineering research operation, the Engineering Societies Library, as an educational activity, two medal awards (John Fritz Medal and Daniel Guggenheim Medal), as recognition activities, and custodian activities (Engineers' Council for Professional Development, Welding Research Council, Alloys of Iron Research, Corrosion Research Council, Research Council on Riveted and Bolted Structural Joints, and so on). Total assets of the corporation total some $12.7 million market value.

Real Estate

United Engineering Center. The United Engineering Center is considered the most important project the Founder Societies have ever attempted. This building, now in the process of construction, will permit expedient co-ordination of inter-Society activities.

Ground-breaking ceremonies were held on Oct. 1, 1959, and construction started on Dec. 14, 1959. Cornerstone ceremonies were held on June 16, 1960, at which time The Honorable Herbert Hoover and Robert F. Wagner, Mayor of the City of New York, addressed the Presidents of the Societies, other distinguished engineers, and public officials. The UEC building is proceeding under a schedule which calls for occupancy during the latter half of 1961. Located adjacent to the United Nations on United Nations Plaza at 47th Street, the site is undoubtedly one of the most desirable in New York City.

General Description. The following are important statistics relating to the new building:

Area of plot	37,024.27 sq ft
Gross area of building	257,640 sq ft
Net office area	174,000 sq ft
Cube of building	3,678,900 cu ft
Height of building above curb	283 ft
Number of stories (including basement and two mechanical equipment floors at top)	21
Floor-to-floor heights—	
Basement to 1st	14 ft–0 in.
1st to 2nd	19 ft–6 in.
3rd to 18th each	12 ft–6 in.
18th to 19th	15 ft–6 in.
19th to 20th	22 ft–0 in.
20th to roof	18 ft–0 in.

Three passenger elevators and 1 passenger-freight elevator, each rated for a 3000-lb load at 700 ft per minute.

One elevator in Library stack area rated for 1200-lb load at 75 ft per minute.

Provisions are included for two additional elevators for passengers.

Welded structural steel framing is utilized throughout the building. Exterior walls are predominantly curtain-wall construction. Glass and blue-tempered spandrel glass, divided into rectilinear patterns by stainless-steel mullions and column sheathing, will enclose most of the tower. Two tower corners and a considerable expanse of base building wall will be faced with limestone.

In addition to executive offices for the Founder and Associate Societies, the new building will include facilities for Engineering Societies Library and Engineering Index. Meeting rooms accommodating approximately 450 people, dining rooms, a cafeteria, and a revolving exhibition of the latest achievements of engineering will contribute toward making this building the center of American engineering activity.

The tower floors will be occupied by the following Founder and Associate Societies:

3rd Floor—United Engineering Trustees, Inc., Engineering Foundation, Engineers Joint Council, Society of Women Engineers, American Institute of Consulting Engineers, Engineers' Council for Professional Development, and Muncipal Engineers of the City of New York.

4th Floor—American Institute of Industrial Engineers and American Society of Heating, Refrigerating and Air-Conditioning Engineers.

5th, 6th, and 7th Floors—The American Society of Mechanical Engineers.

8th Floor—Welding Research Council and American Welding Society.

9th Floor—Illuminating Engineering Society and American Institute of Electrical Engineers.

10th and 11th Floors—American Institute of Electrical Engineers.

12th Floor—American Institute of Chemical Engineers.

13th and 14th Floors—American Institute of Mining, Metallurgical, and Petroleum Engineers.

15th and 16th Floors—Vacant and unfinished (for future expansion).

17th and 18th Floors—American Society of Civil Engineers.

19th and 20th Floors—Mechanical Equipment.

The entire building will be air-conditioned with zoned control. Seventy-five foot-candles of illumination will be maintained in offices.

Fund Raising. The general contract with Turner Construction provides for a guaranteed limit of cost of $8,081,216 for the UEC building. The site cost including demolition and title expenses totals some $2,800,000. Together with architects' fees, fund-raising expense, new building equipment, legal fees, and a building operations fund, the total cost will be about $12.4 million.

The $12.4 million is to be provided by resources as follows:

Depreciation Fund	$ 1,550,000
Sale of 39th Street Property	1,500,000
AIChE Founders Equity	60,000
Industrial Gifts Campaign	5,500,000
Member Gifts Campaign	3,800,000
Total Resources	$12,410,000

Member Gifts Campaign subscriptions as of Sept. 30, 1960, for all the Founder and Associate Societies totaled $3,296,-013, and the Industry Campaign pledges totaled $4,954,237.

The Industrial Campaign, under the leadership of Campaign Chairman Dr. Mervin J. Kelly is nearing its goal.

The Member Gifts Campaign, under Chairman R. E. Dougherty, is aiming vigorously at termination in 1960.

Sales of Engineering Societies Building. Contract of sale for Engineering Societies Building was executed on Sept. 30, 1960, with Develop Realty Corporation, 152 West 42nd Street, New York 36, N. Y. The sale price is $1,500,000 net to UET with brokerage commission to be paid by the purchaser. A deposit of $100,000 was made by the purchaser upon signing of contract; the balance of $1,400,000 is to be paid in cash upon closing. New York State Supreme Court approval of contract of sale has been obtained and closing date of Jan. 19, 1961, has been scheduled; upon closing UET will lease back Engineering Societies Building until such time as the UEC is ready for occupancy.

Engineering Societies Library

Recognizing that the strength of our technology depends to a large extent upon the organization and availability of the world's engineering literature, the Engineering Societies Library, as the educational arm of UET, endeavors to provide engineers with a type of service unmatched elsewhere in the world. Evidence of the usefulness of the Library is demonstrated by a 14 per cent increase in the use of the library in the past year. The Library translation service covers the various languages of the world.

The Library Board has completed specific planning which will permit the development of an even more useful Library in the proposed new UEC. With the expansion of facilities, the Library will be able to extend still further the quantity and the quality of its services to all engineers and to industry.

Engineering Societies Monographs. The Engineering Societies Monographs Committee is composed of two members of each of the Founder Societies, with the Director of the Engineering Societies Library serving as Chairman of the Committee. The Committee evaluates manuscripts submitted to it, and those accepted are published by the McGraw-Hill Book Company. The purposes of this co-operative venture are: To provide monographs of high technical quality within the field of engineering; to rescue from obscurity important technical manuscripts which might not be published commercially because of too limited sale without special introduction; to develop manuscripts to fill gaps in existing literature; to collect into one volume scattered information of especial timeliness on a given subject.

The "Theory of Plates and Shells," by Stephen P. Timoshenko and S. Woinowski-Krieger was published early in the year.

The manuscript of volume two of "Theory of Flow and Fracture of Solids," by A. Nadai, was reviewed and accepted by the Committee, subject to editing for better presentation. Volume one was published as an Engineering Societies Monograph in 1950. The two volumes are a substantial enlargement and revision of Nadai's "Plasticity," 1931, which was the first Engineering Societies Monograph to be published.

Two books in the Engineering Societies Monographs series which have been out of print for some time are to be reprinted by Dover Publications, Inc. "Hydraulic Transients" by George Rich, first published in 1951, is being reprinted, with additional new material being included as an Appendix. "Fluid Mechanics for Hydraulic Engineers" by Hunter Rouse, first published in 1938, is being reprinted without additions. Both books should be available soon.

During the year an arrangement was concluded with University Microfilms, Inc., which makes it possible for anyone to get a Xeroxed reproduction of any Engineering Societies Monograph which is out of print.

Royalties received by the Library this year are $3362 and, since the series started in 1931, amount to $21,456.

Engineering Foundation

The Engineering Foundation, as the research arm of UET, endeavors to advance the frontiers of man's engineering knowledge.

The Engineering Foundation is currently developing a new policy which will tend to utilize more greatly the highly skilled talent in our Engineering Societies' membership, to define voids in our knowledge, and establish needed research in such areas.

A new Director of the Engineering Foundation has been retained on a part-time basis, to pursue development and execution of a new Engineering Foundation policy.

Medal Awards

UET also is custodian of two medal awards: The John Fritz Medal Award "for scientific or industrial achievement in any field of pure or applied science," and the Daniel Guggenheim Medal Award for "notable achievements in the advancement of aeronautics."

The 1961 recipient of the John Fritz Medal is Stephen D. Bechtel as "Engineer, Builder, Industrialist, and leader of broad vision in large construction undertakings, nationally and internationally.... A pioneer in the creation and development of the modern construction industry, which is unequaled throughout the world and which has made possible the pre-eminence of our country in time of war and in time of peace."

The 1960 recipient of the Daniel Guggenheim Medal is Grover Loening as "Pioneer, Engineer, Public Servant, for a lifetime devoted to the advancement of aeronautics in America."

Finances

As of the end of the fiscal year, 1959–1960, UET's Balance Sheet Assets totaled some $11.2, an increase of approximately

$2.3 million over the previous fiscal year.

The total real-estate assets of UET are listed as $8.66 million. There are no mortgages or notes outstanding.

Professional Advisers

Advisers are retained by the Board of Trustees on certain phases of its work in order to obtain the best information available.

They include: Financial Counsel, W. Barton Cummings, Vice-President, Chemical Bank New York Trust Company; Investment Adviser, Wood, Struthers & Company, Milton S. Harrison, Partner; Legal Counsel, Simon Presant; Consulting Architects, Shreve, Lamb & Harmon Associates; Consulting Actuary, George B. Buck; Insurance Advisers, Frank & DuBois; and Auditors, Haskins & Sells, Certified Public Accountants.

Two longtime members of ASME honored at ASME Cincinnati Section meeting in the Engineering Society of Cincinnati: E. A. Muller, **second from left,** Fellow ASME, former president of the King Machine Tool Company, and past-president of the National Machine Tool Builders Association, received a special certificate recognizing his membership in the Society for 70 years. T. B. Morris, **second from right,** former corporation secretary and treasurer of Mitchell Steel Company, received a 50-year ASME service pin. Both awards were presented by W. G. Cornell, **left,** ASME Cincinnati Section Chairman, in conjunction with H. J. Macke, **right,** chairman of the Honors and Awards Committee. Mr. Muller has been responsible for many advances in machine design, and has held several important national and local posts in ASME. Mr. Morris, who is in the engineering design field for Sakrete, Inc., also has been active in ASME.

PEOPLE

Honors and Awards. Three ASME members received honorary DE degrees at the dedication convocation for the new engineering-science building at the University of Toledo in October. The three were: Edwin D. Harrison, Mem. ASME, president of the Georgia Institute of Technology and former dean of the College of Engineering at the University of Toledo; Detlev W. Bronk, Hon. Mem. ASME, president of the Rockefeller Institute and the National Academy of Sciences; and Asa S. Knowles, Mem. ASME, president of Northeastern University and former president of the University of Toledo, during whose regime preliminary plans were made for the new $2-million building financed equally by the city and by industry.

Walker L. Cisler, ASME President and president of Detroit Edison Company, has been chosen 1960 recipient of the American Institute of Consulting Engineers Award of Merit. The award was presented officially at the annual dinner of AICE, held on Tuesday, Nov. 29, 1960, at the Waldorf Astoria Hotel, New York City.

George McKinstry Dick, Mem. ASME, president of the Engineering Institute of Canada, and chief engineer of Canadian Ingersoll-Rand Company, Ltd., has received an honorary DSc degree from the University of Sherbrooke, Que., Canada. Dr. Dick has played an important part in the development of the university's faculty of science, and has made outstanding contributions through almost five decades to Canadian engineering achievement.

J. H. Foote, Mem. ASME, vice-president and director of engineering, Commonwealth Associates, Inc., New York, N. Y., received the Howard Coonley Medal, one of the two highest standards awards for 1960 given by the ASA board of awards. The medal honors each year an executive who has rendered great service in advancing the national economy through voluntary standards. Richard C. Sogge, retired manager, engineering standards, General Electric Company, received the Standards Medal for outstanding leadership in the practical development and application of standards. The awards were presented at the Eleventh National Conference on Standards, held in October at the Sheraton-Atlantic Hotel, New York, N. Y.

Selden B. Crary, Mem. ASME, system analysis engineer, Electric Utility Engineering Section, General Electric Company, has received the AIEE William M. Habirshaw Award for contributions to the stability, reliability, and economy of bulk power transmission systems, and for international leadership in the field.

William Prager, Mem. ASME, L. Herbert Ballou University Professor at Brown University, is the first recipient of the Theodore von Karman Award of the American Society of Civil Engineers.

Harold Francis Smiddy, Mem. ASME, vice-president of General Electric Company, received the distinguished service "Award in Industry" at the annual dinner of the New York Chapter, New York State Society of Professional Engineers, at the Hotel Statler-Hilton in October. Founder of the Advanced Management Institute of General Electric, Mr. Smiddy is a recognized authority in the electrical utility and manufacturing industries.

The Franklin Institute awarded its George R. Henderson Medal to two British engineers for their invention and development of the "Deltic" diesel engine. Herbert Sammons, managing director of D. Napier and Son, Ltd., London, invented the engine, which was first used in small craft of the Royal Navy and is now used for railway locomotives. Ernest Chatterton, retired chief engineer, Piston Engine Division of D. Napier, designed and developed it.

The Franklin Institute Walton Clark Medals went to two engineers from

Decatur, Ind., who devised a process to seal and prevent leaks in gas mains. Robert W. Cook, vice-president of C. W. Fuelling, Inc., invented an electronic sensing device that locates a leaking joint in gas mains with internal diameters from 8 to 24 in. He and Lee F. McBride, staff member, developed the applicator that paints the joint with a sealer.

Chauncey Starr, vice-president of North American Aviation, Inc., and president of its Atomics International Division, was inducted October 29 as an Eminent Member of Eta Kappa Nu, national electrical engineering honor society. The honor is reserved for individuals who have demonstrated outstanding leadership in the electrical engineering field.

New Officers. John V. Grimaldi, Mem. ASME, consultant for safety and plant protection for General Electric Company, is the new first vice-president of the American Society of Safety Engineers. He was installed at the society's annual meeting in the Waldorf Room of the Conrad Hilton Hotel, Chicago, Ill., in October. Dr. Grimaldi has served as Chairman of the Executive Committee of the Safety Division, ASME.

Ronald R. McNaughton, manager of the metallurgical division, The Consolidated Mining and Smelting Company of Canada, Ltd., has been elected president for 1961 of AIME. He will take office on Feb. 28, 1961, at the institute's annual meeting in St. Louis, Mo.

James C. Gray, administrative vice-president of raw materials, U. S. Steel Corp., Pittsburgh, Pa., has been elected president for 1961 of the Society of Mining Engineers, a constituent of AIME. He will be installed February 28.

Also to take office in St. Louis on February 28 is John S. Smart, Jr., general sales manager of the American Smelting and Refining Company, New York, N. Y., who has been elected 1961 president of The Metallurgical Society of AIME; and J. Harry Jackson, Mem. ASME, manager of the department of metallurgy, Battelle Memorial Institute, who will be a director for one year representing the Institute of Metals Division of AIME. He is one of several directors to be installed.

Ralph H. Tripp, assistant director, Flight Test Division, Grumman Aircraft Engineering Corp., Bethpage, L. I., has assumed office as president of ISA for 1960–1961. Installed with him at the society's 15th annual meeting in New York City in September was Philip A. Sprague, president of The Hays Corp., Michigan City, Ind., who was chosen president-elect-secretary.

Richard G. Slauer, manager of engineering for Sylvania Electric Products Inc., Wheeling, West Va., has taken office as the new president of the Illuminating Engineering Society, professional organization of the U. S. and Canadian lighting profession. He had previously completed a two-year term as vice-president of the society.

Frank W. Reynolds, manager of IBM's plastics laboratory at Endicott, N. Y., has been elected the 1961 president of SPE. Mr. Reynolds was instrumental in organizing the laboratory in 1940, and has been its manager since 1951.

Raymond Spilman, principal in the industrial design firm of Raymond Spilman, New York, N. Y., has taken office as president of the American Society of Industrial Designers. He and other officers for 1960–1961 were installed at a dinner closing the society's sixteenth annual meeting October 28 in Chicago, Ill.

Allen V. Astin, director of the National Bureau of Standards, was made a lifetime honorary member of ISA at the society's fall instrument-automation conference and exhibit September 27 in New York. He was the eighth man to be so honored by the society since it was founded in 1946. Among ten members of the society to be named fellows were the following ASME members: David M. Boyd, Jr., head of the Instruments Group, Engineering Department, Universal Oil Products Company, Des Plaines, Ill., for contributions in the field of process controllers for the chemical industry and of instrumentation education; Louis Gess, technical services consultant, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa., for contributions in the field of measurement and control of liquid flow; Clesson Ernest Mason, of the C. E. Mason Laboratory, Lowell, Ohio, for contributions in conceiving and developing multifunction feedback controllers; Coleman B. Moore, president of Moore Products Company, Philadelphia, Pa., for contributions in the field of pneumatics for measurement, transmission, and control; Nathaniel B. Nichols, vice-president and chief engineer, Taylor Instrument Companies, Rochester, N. Y., for contributions to the science of pneumatic and electronic instrumentation; and Herbert W. Ziebol, assistant to vice-president of engineering, General Precision Equipment Corp., New York, N. Y., for contributions in the field of fluid and electronic instrumentation design.

Reginald J. S. Pigott, President, 1951–1952, and Fellow ASME, former director of engineering division, Gulf Research and Development Company, Pittsburgh, Pa., was also made a fellow

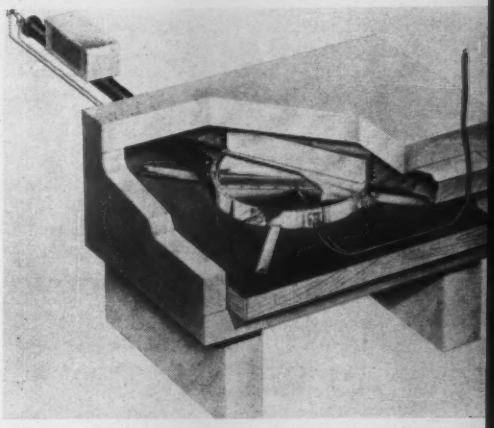
Gulf Coast Section Chairman, E. L. Rivenbark, **left,** of Mobile, Ala., receives charter for the new ASME Gulf Coast Section from John W. Little, Vice-President, ASME Region IV. The new Section, 89th ASME Section in the U. S., Canada, and Mexico, is composed of members from eight Alabama and eight Mississippi counties. It will meet on the third Tuesday of every month at 6:30 p.m. at the Cawthon Hotel in Mobile. The new group applied for a charter as a full section early this past summer, at which time it was a subsection of the Birmingham Section.

of ISA. He was cited for contributions in the field of instrumentation, particularly in flow metering.

Campus Data. JOHN F. LEE, Assoc. Mem. ASME, head of the department of mechanical engineering at North Carolina State College, will become president of the State University of New York in Long Island, effective February 1. The appointment will give Professor Lee supervision of a graduate college, as well as colleges of science and mathematics, arts and letters, engineering, and associated divisions. Professor Lee, author of more than 60 publications, has received world-wide acclaim for his contributions to the science of satistical thermodynamics.

Engineering World. HENDLEY BLACKMON, Mem. ASME, engineering manager of association activities at Westinghouse Electric Corporation, Pittsburgh, Pa., headed a delegation of 26 U. S. engineers attending a general meeting of the International Electrotechnical Commission in New Delhi, India, October 30 through November 12. The engineers, representing the electrical industry, technical societies, and government agencies, were primarily concerned with assisting the development of international standards recommendations for the electrical and related industries.

Cyclotron's Vitals—Vacuum pumps, control valves, and a 5-ft coaxial feed line for supplying acceleration energy make up the "plumbing" of a desk-sized cyclotron built for Pomona College, Claremont, Calif., by Hughes Aircraft Company. The machine's iron-block electromagnet, mounted on concrete supports **at right,** contains semicircular vacuum tanks in which positively charged particles are accelerated. Viewers, **left to right,** are Dr. E. Wilson Lyon, president of Pomona College; Frank Seaver, college trustee who donated the machine; and Dr. Edward M. Fryer, acting chairman of the college's physics department.



How Cyclotron Works—Cutaway sketch shows elements of Pomona cyclotron. The protons to be accelerated are obtained from hydrogen gas piped into vacuum tank, **at center,** and heated by electrical filament at end of iron source near face of a semicircular metal chamber, called a Dee. Accelerating r-f energy is furnished by oscillator, **upper left.** Protons are driven in ever-increasing circles, receiving a "kick" of 17.5 kv each time they cross face of Dee, until they are accelerated to 2 Mev.

EDUCATION

Articulate Engineers

● How can you turn out articulate scientists and engineers? Everybody talks about the professional man's inability to tell others precisely what is on his mind, but nobody does anything about it, say teachers at Stevens Institute of Technology.

The real difficulty, say Stevens humanities professors, is incomplete thinking, the inability to assemble thoughts, not the scarcity of words to express them. Stevens is taking a fresh approach to the problem by requiring a new freshman writing course, the first of its kind in an engineering college, designed to help students recognize how much their attitudes and prejudices have shaped their awareness of things around them, whether they are writing about their adjustment to college life, a Van Gogh painting, or Einstein's theory of relativity.

Twice a week the freshmen write a 250-word paper on themes contrived to make them aware that a writer's first task is to establish a point of view in his approach to a problem, and that Einstein and Newton first had to structure their thoughts before they could express order in the physical universe. Several students have already reported that the course has helped them in solving physics problems.

Pomona Reactor

A compact cyclotron no larger than an office desk was unveiled in October at Pomona College, Claremont, Calif., as part of the college's 73rd Founder's Day ceremonies.

The small "atom smasher," built by Hughes Aircraft Company, designed and maintained strictly for undergraduate instructional purposes, was donated to the college by alumnus and trustee Frank Seaver of Los Angeles.

According to Dr. Edward M. Fryer, acting chairman of the Pomona physics department, the cyclotron will be the backbone of the nuclear physics instruction at the college. Every physics major will eventually have a chance to do individual work on the cyclotron. Despite its small size, Dr. Fryer emphasized that the cyclotron is also usable for major research projects.

"This will be more than a black box out of which radioactivity arises," Dr. Fryer said. "The cyclotron itself exemplifies many of the fundamental principles of physics. The beauty of this particular machine is its simplicity. You don't have to be a PhD to operate it."

The cyclotron measures approximately 3 × 5 ft and weighs seven tons. The machine is practically foolproof from the standpoint of safety, Dr. Fryer said. For example, three interlocks on its door make it impossible to operate unless it is properly secured.

The cyclotron was designed by physicists Byron Wright and Kenneth MacKenzie of UCLA, former students of Ernest O. Lawrence, inventor of the

original cyclotron. They began construction of the high-energy machine at their MevA Corporation in Santa Monica, Calif., last year. Hughes purchased MevA last May.

Industrial Standardization

John Gaillard, Mem. ASME, consultant on industrial standardization, will hold his next five-day seminar in the Engineering Societies Building, 29 West 39th Street, New York 18, N. Y., from Jan. 23 through 27, 1961.

His seminars are intended to assist top management in establishing the most effective administrative setup, procedure, and program for handling standardization work in the individual company, and in training staff men in the functions of the standards engineer, including the art of writing specifications. A full day will be reserved for round-table discussion of problems of special interest to the companies represented.

The Gaillard Seminars have been attended so far by 427 men from 238 organizations in the U. S. and five other countries. For details and registration, write to Dr. John Gaillard, 135 Old Palisade Road, Fort Lee, N. J.

Digital Computer Uses

Two major developments at the University of Michigan's College of Engineering are revealing important new uses for the high-speed digital computer. Results will be "generally applicable to every area of engineering analysis, system design, and calculations of performance," said Associate Dean Glenn V. Edmonson, Mem. ASME, director of the project.

The developments are: A system-simultor program that enables the computer to organize and produce a procedure to calculate the performance of a physical system when given a general, technical English language description of the system; and a program enabling the computer to produce analytical equations, or models, of phenomena that depend on many variable interacting factors.

Whereas, before, a man set up the problem and the computer did only the calculation, the new procedure is to give the computer the data and let it set up the problem itself. The project from which the developments emerge concerns power-plant design, and was undertaken through the sponsorship of Consumers Power Company and Commonwealth Associates.

Grants

● An extensive program of institutional grants designed to strengthen scientific research and research-training in colleges and universities throughout the nation has been announced by the National Science Foundation. The grants are part of an experimental program to provide flexibility in institutional research activities. As such, they are being given without specification as to their particular use. Amounts of grants allowable to an institution under the program will be limited to five per cent of foundation research grant payments made to it during the previous year.

● A series of grants to strengthen and expand engineering education at the doctoral level in southern universities has been announced by the Ford Foundation. Totaling $3,110,000, they will go to the four institutions that award nearly all the doctoral degrees in engineering in the south. The universities and the amounts they will receive are: University of Florida, $695,000; Georgia Institute of Technology, $680,000; North Carolina State College, $760,000; and the University of Texas, $975,000.

Henry T. Heald, Hon. Mem. ASME, president of the Ford Foundation, said that the opportunities offered by the grants for the further development of present faculties and the training of additional graduate students should contribute to the strengthening of engineering education in other institutions in the south by making more and better engineering teachers available. The grants will provide for hiring new faculty members, aiding the professional development of present faculty members and graduate students, and generally developing doctoral education in engineering.

● The Atomic Energy Commission has extended through June 30, 1964, its programs of assistance for nuclear education in United States nonprofit educational and medical institutions. These programs, some of which were originally scheduled to be terminated by June 30, 1961, are intended to keep the U. S. in the forefront of support for scientific and technological education in the areas of the physical and life sciences and engineering related to atomic energy.

Assistance will be continued on the same bases as in the past, except in the reactor-technology program, where no further grants will be made for the construction or purchase of teaching reactors. However, the commission will continue to loan special nuclear source materials to qualified institutions. The training-equipment grant program will be changed from the furnishing of equipment for use in the education of reactor engineering specialists to the furnishing of equipment useful in general nuclear education in colleges of arts and sciences in addition to engineering colleges.

Fellowships and Scholarships

● National Science Foundation co-operative graduate fellowships are available at Lowell Technological Institute, Lowell, Mass., for the 1961–1962 academic year. Applications must be received by Dr. Chapin A. Harris, director, by Nov. 4, 1960. Several NSF summer fellowships for graduate teaching assistants also are open for next summer at the institute. Closing date for the receipt of summer fellowship applications is Dec. 9, 1960. All fellowship recipients will be notified of their awards on March 15, 1961.

● Princeton University is again offering its graduate plastics program, with fundamental research in plastics leading to the degree of MS in engineering. Fellowships with stipends of from $1500 to $2100 plus tuition and fees are available. Applicants must hold a BS in engineering or physical science. For further information, contact Prof. Louis F. Rahm, director, Plastics Laboratory, Princeton University, Princeton, N. J.

New Programs

● The Ford Foundation has awarded a $700,000 grant to the Polytechnic Institute of Brooklyn to establish an honors program in science and engineering that will enable exceptional students to receive a doctorate in six years of full-time study. The program, designed to educate research scientists and engineers from the freshman year through the doctorate, will award a BS degree at the end of the undergraduate study.

● Columbia University's Institute of Flight Structures has been awarded a grant of $320,000 by the Daniel and Florence Guggenheim Foundation to support its program of research and education in flight structures for air and space flight. Students admitted to the program must have a BS degree in engineering, mathematics, or physics; and may work toward the master's, and then the engineer's or doctor's degrees. Hans H. Bleich, Mem. ASME, professor of civil engineering, is director of the institute. Prof. Alfred M. Freudenthal, Mem. ASME, and George Herrmann, associate professor, Mem. ASME, are staff members.

● Economic, industrial, and occupational problems that could be expected to arise from national or world-wide disarmament are coming under the scrutiny of Columbia University graduate students in a new course offered by the university. In the seminar called "The Economics of Disarmament," students will examine the issue from the viewpoints of engineers, economists, businessmen, and industrialists.

The seminar is being sponsored jointly by Seymour Melman, Assoc. Mem. ASME, associate professor of industrial engineering; William Vickrey, professor of economics; and Emile Benoit, associate professor of international business.

"The problems of disarmament can be seen on a small scale even today when there are major shifts in the location of industries or in the character of the nation's military program," Professor Melman said. "Our studies should be relevant to cases such as these." An instructor at Columbia since 1948, he is editor of "Inspection for Disarmament," a book published in 1958 that is considered a basic reference on the disarmament problem.

INDUSTRIAL FILMS

Nucerite

NUCERITE, a new construction material, is the subject of a 16-min, 16-mm color-sound film now available to technical groups from The Pfaudler Company, a division of Pfaudler Permutit Inc., Rochester, N. Y. The film should be of particular interest to researchers and engineers engaged in chemical, nuclear, and space technology.

Nucerite is a new ceramic metal composition that exhibits remarkable resistance to attack in hot, corrosive environments. It represents a significant advance over similar corrosion-resistant ceramic material in mechanical strength, thermal shock resistance, abrasion resistance, heat transfer, and high temperature stability.

Copies of the film may be obtained upon request from the advertising manager, The Pfaudler Company, 1123 West Avenue, Rochester, N. Y.

Copper-Piping Practice

"COPPER Tube in Building Construction," a new 30-min sound-color film, has been released by Revere Copper and Brass, Inc., New York, N. Y. It is the first film to cover the entire subject of good copper-piping practice, and is designed to interest contractors and mechanics as well as architects and engineers who must specify lighter and stronger materials to utilize every inch of space.

The film was made with the co-operation of Revere's technical advisory staff, and produced for Revere by Hans Tiesler of Tiesler Productions, New York, N. Y. Available from: Revere Copper and Brass, Inc., 230 Park Avenue, New York 17, N. Y.

Industrial Trucks

THREE new slide films on industrial trucks are available from the Clark Equipment Company, Battle Creek, Mich.

"Servicing the Clarklift Hydratork" shows how to keep the Hydratork transmission on Clarklift fork trucks in excellent operating condition. The 43-min film describes how the power-shifted transmission works and how to trouble-shoot causes of malfunction.

"Lifting The Burden" is a sound and color, 20-min, slide film showing situations where "Powrworker" battery-powered hand trucks can be used advantageously.

"Dollars and Sense" is a sound and color, 20-min, slide film illustrating applications and advantages of pneumatic-tire fork trucks of 15,000 to 40,000-lb capacity.

All three films may be obtained free of charge from the Slide Film Department, Industrial Truck Division, Clark Equipment Company, Battle Creek, Mich.

Arc-Welding Techniques

"FUNDAMENTALS of Manual Shielded Arc-Welding Techniques," a 45-min, 16-mm, full-color, sound film on shielded arc-welding procedures, has been issued by Air Reduction Sales Company, New York, N. Y.

Adapted from General Electric Company's previously released six-film series, "Inside Arc-Welding," the Airco film has been edited to two reels. Part one covers flat and horizontal arc-welding techniques, and is 22-min in duration. The 23-min second reel studies vertical and overhead arc-welding procedures. Extremely clear camera close-ups of the welding arc in actual operation are featured. The four basic principles of arc-welding, current setting, speed of travel, length of arc, and angle of electrode, are graphically explained, along with good and bad examples of arc-welding.

Prints may be obtained on loan without charge by contacting the local representative of Air Reduction Sales Company, a division of Air Reduction Company, Inc., 150 East 42nd Street, New York 17, N. Y.

Iron

THE story of gray iron castings is told in a 30-min color film entitled "Rice Bowls to Rockets," the first of a nine-film package being produced by the Gray Iron Founders' Society, Inc., Cleveland, Ohio. Two sound slide films, also produced by the society as part of the same educational program, are entitled "What Is Cast Iron?" and "Properties of Gray Iron." The object of the program is to bring product designers, castings buyers, and other metalworking executives up to date on the increasing possibilities presented by the growing family of iron castings.

"Rice Bowls to Rockets," narrated by Truman Bradley, ranges in time from the Chou dynasty in ancient China to today's concert stage, to the testing laboratory, and the engineering section of the Martin Company, in demonstrating many unique and useful properties of gray iron castings.

The film package is being sponsored by the American Coke and Coal Chemicals Institute and merchant coke industry. It is being produced by Academy-McLarty Productions, Buffalo, N. Y. Most of the films in the series, all of which are in color, will be sound slide films covering separate subjects of a technical nature. They may be obtained through the Gray Iron Founders' Society, East Sixth Building, Cleveland 14, Ohio.

Computers—Behavior of Waves

TWO NEW sound motion pictures for use in college science and engineering classes have just been produced by Bell Telephone Laboratories. Entitled "Memory Devices" and "Similarities in Wave Behavior," they were prepared under the guidance of Bell Laboratories' scientists and engineers.

"Memory Devices" is a 16-mm, sound, color film, 27-min in length, that shows information storage devices used in modern computing machine memories and explains how binary information is stored in them.

The ideas of superposition, standing waves, and resonance are shown in slow motion in "Similarities in Wave Behavior," a 16 mm, sound, black-and-white film of a demonstration-lecture by Dr. J. N. Shive of the Bell Laboratories.

He discusses the similarities that exist in the behavior of waves in various mechanical, electrical, acoustical, and optical wave systems. The film is $23\frac{1}{4}$ min long.

The films are the seventh and eighth productions completed by Bell Laboratories' Educational Film Production Unit, and are available on free loan through local Bell Telephone Company offices.

LITERATURE

ASME Publications

THE following publications are available from the ASME Order Department, 29 West 39th Street, New York, 18, N. Y.

"Manufacturers of Dust and Fume Control Equipment," a 13-page listing of U.S. manufacturers and equipment, has been published by the Subcommittee on Current Projects and Trends of the ASME Committee on Air-Pollution Controls. Price: $1.50 a copy.

"Instruments for the Study of Atmospheric Pollution," Third Edition, has been published by Subcommittee No. 2 on Current Projects and Trends of the ASME Committee on Air-Pollution Controls. With a format improved over the original report, and the inclusion of some former omissions, it contains the results of a survey of commercially available instruments for the study of atmospheric pollution. Price: $3.

"The Role of Viscosity in Lubrication," the proceedings of an ASME symposium sponsored by the Lubrication Division and held March 10–11, 1958, has been published. The 108-page book, which includes 13 papers, is divided into four parts, discussing viscosity characteristics of lubricants, sensitivity to viscosity, design criteria, and research contributions. Price: $4.50.

Standards

● "American Standard for Pipe Threads," B2.1-1960, which has been published in newly revised form, still is based on a system of pipe threads known since the 1880's as the Briggs Standard, which in turn incorporated the nominal sizes of pipe (ten in. and under) and the pitches of the thread established even earlier—between 1820 and 1840; a 120-year history few standards can top. In the latest revision, the Dryseal pressure tight joints have been published separately as American Standard B2.2-1960. Published by ASME, revision B2.1-1960 is available at $3 a copy; B2.2-1960 is $3.50 a copy.

● "Metallizing Symbols," ASA Y32.12-1960, $1.

● "Milling Cutters," ASA B5.3-1960, $3.

● "Involute Splines, Serrations and Inspection," ASA B5.15-1960, $5.

● "American Standard Cast-Iron Pipe Flanges and Flanged Fittings," B16.1-1960, Class 125, and B16.2-1960, Class 250, $1.50, each.

● "American Standard Square and Hexagon Bolts and Nuts," B18.2-1960, a revision, $2.

● "Unified Screw Threads," ASA B1.1-1960, $5.

Copies of the Standards are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

New Journals

● **Nuclear Engineering Abstracts.** Volume one, number one of this abstracting journal was published July 1, 1960, and it accents engineering. The purpose, as stated in the Introduction, is to present in a readily comprehensible style and to record in a readily classified form developments and trends reflected in the current technical literature. The new journal will appear four times a year. Annual subscription rates, postpaid, are £6 6s. 0d. ($18.50). Single copies are £1 12s. 6d. ($4.50). Available from Silver End Documentary Publications, Ltd., 9–11, Tottenham Street, London, W.1., England.

● "Cryogenics" is a new journal dealing specifically with the realm of low-temperature engineering and research. A quarterly, its purpose is "to publish original papers on all aspects of low-temperature engineering and research and to feature in each issue one invited survey article written by an authority on the subject." The first issue contains a discussion of the prospects of nuclear cooling, contributed by Dr. N. Kurti, F.R.S., of Clarendon Laboratory, Oxford. There also are nine original papers from Britain, America, France, and the Netherlands, with abstracts of each in French, German, Russian, and English. The four-language abstracts will be a regular feature of the journal, which will also publish papers dealing with the increased use of cryogenic propellants as rocket fuels, new methods of handling, storage, and transport, low-temperature electronics, and other technical problems related to cryogenics. A year's subscription may be obtained for £5 ($15) from the publishers, Heywood and Company, Ltd., Carlton House, Gt. Queen Street, London, W.C.2., England.

● "Motion Research and Engineering," a new publication of SKF Industries, Inc., is dedicated to the advancement of the art and science of motion. Future issues, like the inaugural one, will touch upon some of the more significant engineering challenges, application trends, and developments in bearings. Additional information may be obtained from SKF Industries, Inc., Front Street and Erie Avenue, Philadelphia 32, Pa.

● "Datex Digest," a new quarterly periodical published by Datex Corporation, Monrovia, Calif., made its debut early in November. Directed to the busy engineer seeking quick technical data, the digest-size publication will contain condensed application stories accompanied by sources for additional information. The first guest editorial was by John C. Green, director of the Commerce Department's Office of Technical Services, the top government man in the dissemination of technical information.

Government Publications

OTS

● "The Explosive Working of Metals" (PB 161828), relates current operations in explosive forging to some fundamental aspects of forces, pressures, velocities, and other factors. Parts forming, sizing, shaping, cutting, compacting, welding, and other metalworking operations performed by energy released from either detonating or deflagrating explosive are evaluated. The 48-page report reviews several of these basic types of operation currently in use on a production basis, and others still in the applied research area of investigation. Price: $1.50, from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

● "Physical and Mechanical Properties of the Cobalt-Chromium-Tungsten Alloy WI-52" (PB 161216), is a compilation of previously unpublished data on the new superalloy WI-52 gathered from various private companies. It includes details on specifications and names of the alloy, chemical composition, fabrication, oxidation resistance, and physical and mechanical properties. The 21-page report is available at 50 cents from OTS, U. S. Department of Commerce, Washington 25, D. C.

MEETINGS OF OTHER SOCIETIES

December 17

Institute of the Aeronautical Sciences, Wright Brothers Lecture, Smithsonian Institute, Washington, D. C.

December 26–31

AAAS, annual meeting, Philadelphia, Pa.

January 9–11, 1961

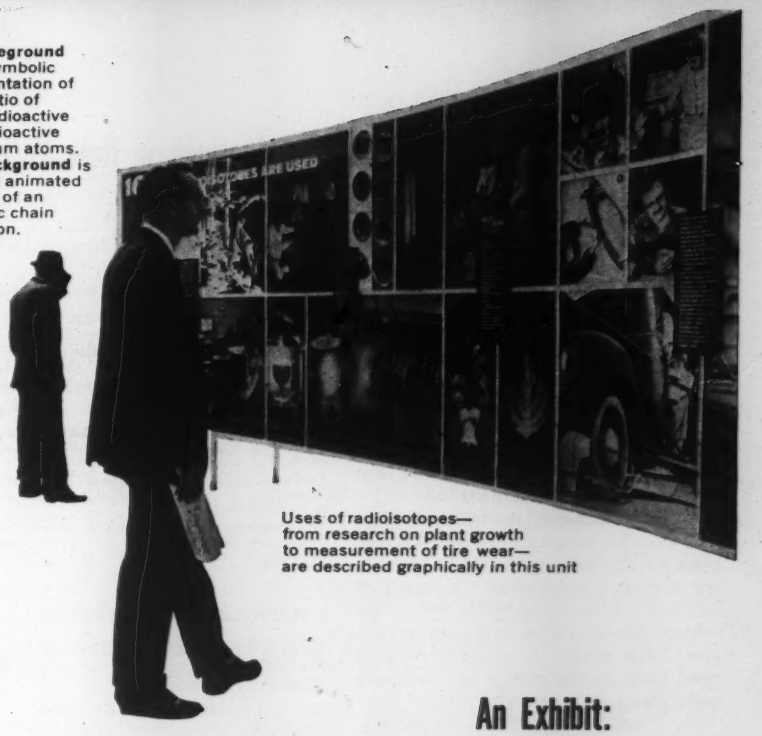
AIEE, IRE, and American Society for Quality Control, reliability and quality control meeting, Bellevue-Stratford Hotel, Philadelphia, Pa.

January 9–13, 1961

SAE, annual meeting, Cobo Hall, Detroit, Mich.

(For ASME Coming Events, see page 121.)

In **foreground** is a symbolic presentation of the ratio of nonradioactive to radioactive uranium atoms. In **background** is a 60-ft animated mural of an atomic chain reaction.



Uses of radioisotopes—from research on plant growth to measurement of tire wear—are described graphically in this unit

An Exhibit:

"ATOMIC ENERGY IN ACTION"

For Better Understanding:

New York City's Park Avenue has a new attraction: The "Atomic Energy in Action" exhibit which was opened recently to the public by Union Carbide Corporation. Occupying the front lobby of the Union Carbide Building, the display is designed to give the public a better understanding of atomic energy.

The story of the uranium atom is portrayed as beginning with man's early concept of the atom over 25 centuries ago and is traced through the ages to the present. How uranium is mined and processed and how it is used in atomic reactors to benefit mankind forms a major part of the exhibit.

A 60-ft-long mural depicts a chain reaction of splitting atoms. This dramatic demonstration, which is the first ever devised on such a scale, shows how the chain reaction spreads to other atoms by means of high-speed subatomic bullets called neutrons.

Visitors will see a model of the uranium atom, whose diameter is 10 billion, trillion, trillion times that of the actual atom. Its 92 electrons are depicted as small lights orbiting around a cluster of protons and neutrons which make up the atom's center or nucleus.

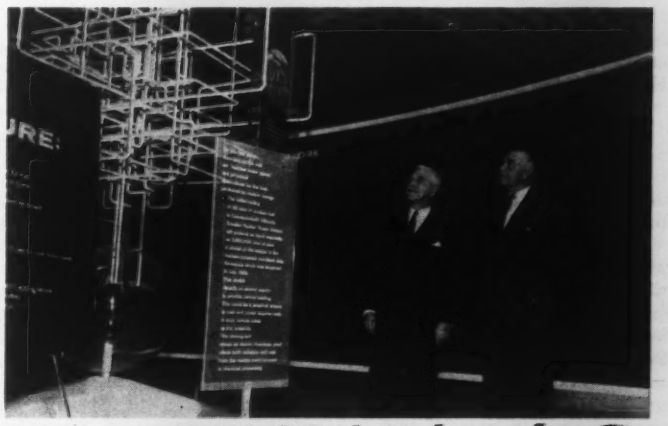
A 21-ft panoramic view of the Colorado Plateau sets the stage for the uranium mining and milling section of the exhibit.

How uranium is used in an atomic reactor is illustrated by the exhibit's main feature—a full-scale model of a pool-type research reactor. Visitors can view from a platform a simulated operating cycle of a reactor.

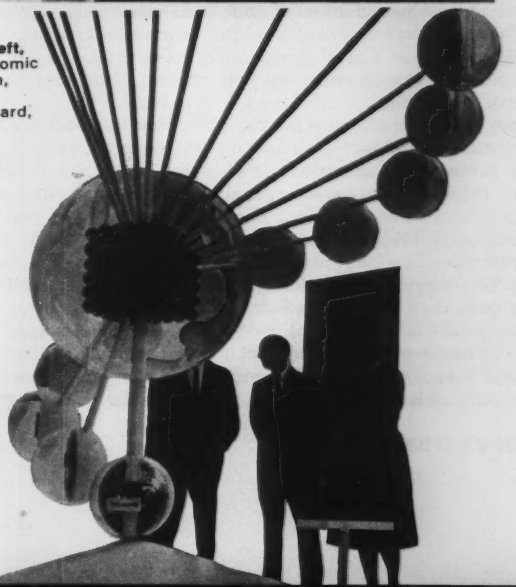
Applications of atomic energy also are covered. One section deals with the production and use of radioisotopes, a large art form depicts how they are used in medicine, agriculture, and industry.

Another section shows how atomic energy has been applied to the generation of electricity. This section also features the use of a reactor for propulsion and two proposed applications where reactors may be used for chemical processing and space heat.

The exhibit has been designed for the general public and will be open to school groups and civic societies as well.



John A. McCone, **left**, Chairman, U. S. Atomic Energy Commission, and Morse G. Dial, Chairman of the Board, Union Carbide, gaze at section depicting proposed applications of atomic energy



Typical radioisotopes are listed according to their half-lives in this display

Attention ASME Members—Meetings in New York City Merit Your Attention

THE third annual meeting of the Society for the History of Technology will be held Dec. 27–29, 1960, with headquarters at the Belmont Plaza Hotel in New York City. The Society sponsors meetings at which various aspects of technological history will be investigated. This year the society will be meeting jointly with the following: Section L (History and Philosophy of Science) and Section M (Engineering) of the American Association for the Advancement of Science, the History of Science Society, and the American Historical Association.

A session of major importance, Friday, December 30, features a discussion on the place nuclear subjects should be given in the university curriculum. To teach or not to teach nuclear subjects—when and where—has been a much discussed question; this session is designed to shed some light on the subject and to clarify some issues.

On December 29, the AAAS program lists ASME President Walker L. Cisler as the Tau Beta Pi speaker. His address entitled "The Increasing Significance of Energy in an Expanding World," will be delivered in the evening in the Grand Ballroom of the Roosevelt Hotel.

Another speaker of world note at the AAAS annual meeting will be Sir C. P. Snow. He is scheduled to give a general address December 27 at 8:00 p.m.

The Society for the History of Technology program thus far lists the following:

▶TUESDAY, DECEMBER 27

Joint Session With the History of Science Society — **Belmont Plaza Hotel, Baroque Room, 2:00 p.m.**

Topic: **Fairly Recent Science and Technology**

Chairman: *Lynn White, Jr.*, University of California, Los Angeles

Abraham Gottlieb Werner's Ideas on Science and Education, by *Alexander M. Ospenat*, University of North Dakota

The Engineering Gap Between Faraday's Discovery of Electromagnetic Induction and the Electric Dynamo, by *Harold I. Sharlin*, Polytechnic Institute of Brooklyn

▶WEDNESDAY, DECEMBER 28

Joint Session With the American Historical Association — **Statler Hilton Hotel, 10:00 a.m.**

Topic: **Technology as Cause in History**

Chairman: *Stanley Pargellis*, Newberry Library, Chicago, Ill.

Technology—Neglected Clue to Historical Change, by *Roger Burlingame*, West Redding, Conn.

History—Neglected Clue to Technological Change, by *Lewis Mumford*, University of Pennsylvania

Commentator: *H. Stuart Hughes*, Harvard University

Joint Session With Sections L and M, AAAS — **Belmont Plaza Hotel, Baroque Room, 2:00 p.m.**

Topic: **Ninteenth Century Technology**

Chairman: *Sidney Withington*, New Haven, Conn.

New Evaluations in the History of the Petroleum Industry in the Nineteenth Century, by *Arnold R. Daum*, Northwestern University

The British Electrical Industry Lag, 1882–1888, by *Thomas P. Hughes*, Washington and Lee University

Commentator: *Bern Dibner*, Burndy Library, Norwalk, Conn.

▶THURSDAY, DECEMBER 29

Luncheon — **Belmont Plaza Hotel, Crystal Room, 2:00 p.m.**

Presidential Address: *Dr. Lynn White, Jr.*

Joint Session With Sections L and M, AAAS — **Belmont Plaza Hotel, 2:00 p.m.**

Topic: **Automation**

Chairman: *Preston R. Bassett*, Ridgefield, Conn.

Speakers: *James R. Bright*, Harvard University
John Diebold, New York City

Commentator: *A. J. Jaffe*, Columbia University

▶FRIDAY, DECEMBER 30

Joint Panel With Sections B (Physics) and M, AAAS — **Biltmore Hotel, Room A, 9:00 a.m.**

Panel Discussion: The Place of Nuclear Engineering in the University Curriculum

Panel Moderator: *John W. Healy*, General Electric Company, New York City

Panel Members: *Thomas B. Drew*, Columbia University
Irving Kaplan, M. I. T.
John Lamarsh, Cornell University
V. Lawrence Parsegian, Rensselaer Polytechnic Institute

Engineering Index Does Its Part to Help Build a Stronger America

FOR MORE than 40 per cent of the life of the Nation, and for more than 75 years, "The Engineering Index" has been serving the Engineering Profession in the complex task of keeping abreast of all the developments in all branches of engineering.

In the Beginning. At the outset the task was relatively simple compared with today's great volume of printed matter developed to the myriad mass of complicated processes and materials used in engineering. When The Engineering Index began there were three fundamental branches of engineering.

But Now. Now specialization has made necessary many branches of engineering such as aeronautical, chemical, civil, electrical, industrial, mechanical, metallurgical, mining, and nuclear. These are subdivided by The Engineering Index into 249 Divisions.

Today The Engineering Index is reviewing more than 700 engineering and technical periodicals published in 44 countries, plus another 1000 printed in the United States. In order to review and annotate this enormous mass of material it has been necessary to develop a staff of editors who are engineering linguists, competent to select and translate into English what resulted in a total of 34,000 abstracts in 1959. The complete job encompasses not only the material published in these nearly 1800 publications, but also the publications of scientific, engineering, and technical societies; engineering and industrial periodicals; and reports of government bureaus, engineering experiment stations, universities, and other research organizations. Not necessarily all articles are indexed.

How Selections Are Made. Selection is made on the basis of articles dealing with the science and art of engineering. Articles on pure science, economics, commerce, and trade; editorials, news items, notices of meetings, trade announcements, and the like, are included only when considered of primary importance.

The bound volume of the Index issued in the summer of 1960 contains a 12-page list of technical publications received by the Index, and 96 pages devoted to an author index. The volume is comprehensive, covering all applications of Engineering methods and concepts to industry, agriculture, mining—the entire economy. No other abstracting service covers world-wide technological literature as extensively. Libraries—public and special—industrial firms, trade associations, government bureaus, schools and universities, and many individual engineers, and technological specialists subscribe to keep informed, or for reference and bibliographical help on specific projects.

In addition to the bound volume, The Engineering Index issues a daily or weekly Card Index Service to assist those wishing to keep strictly up-to-date with a rapid review of each development in any and all of the 249 Divisions of Engineering—thereby enabling subscribers to receive only the particular portions of the entire service which fit their requirements.

Subscriptions cost from $12 to $45 annually for each of the 249 Divisions of Engineering selected by the subscriber, and received by him weekly. A com-

plete Catalog fully describing the coverage in each of the 249 Divisions, with prices, and so on, is available without charge on request.

A combination subscription to those Divisions of the Card Service in which one had special interest, plus an annual subscription to the bound volume with its complete coverage of engineering in all its divisions, puts one in possession of a quantity of valuable engineering information that saves a vast amount of time and money usually spent for subscriptions to periodicals, plus the time to peruse them sufficiently to locate all the items in which one is interested. Too, a minimum amount of filing and shelf space is required.

Nuclear Reactor

A DESIGN study for a nuclear reactor at Picatinny Arsenal near Dover, N. J., was awarded recently to Allis-Chalmers Manufacturing Company and Vitro Engineering Company by the U. S. Army Ordnance Corps. The study will be the first step in a program aimed at designing and building a 20,000 to 30,000-kw nuclear research and materials-testing reactor for use by the Picatinny Arsenal staff and other Ordnance Corps agencies.

AEC Contract

THE Franklin Institute Laboratories have received a contract from the Atomic Energy Commission to study the design of containers, larger than one ton, used to ship radioactive materials. The study will also survey all existing data on highway and rail accidents in an attempt to define major types of accidents and their possible effects on containers for radioactive material.

The container study is the second major program the Franklin Institute Laboratories have undertaken for the AEC this year. In February the Institute began work on a critical survey of materials and equipment for use in high-temperature gas-cooled reactors.

Southwest Research Institute in San Antonio Revisited

- 1960 Annual Meeting AEC Welding Forum
- The Institute three and a half years later

AEC Welding Forum

EIGHTY of the nation's leading engineers in the field of welding engineering met in San Antonio, Texas, at the Granada Hotel, for the tenth annual Atomic Energy Commission Welding Forum. The meeting, arranged by Southwest Research Institute, was held October 4 through 6.

An annual conference since 1950, the Welding Forum provides a vehicle for discussion of problems encountered in both governmental and industrial construction and research. Frank W. Davis, Mem. ASME, of Southwest Research Institute is chairman of the Forum.

Among the papers presented in the nonclassified section of the meeting were reports of the welding of Type 347 stainless steel, and stress relieving of stainless steel, aluminum, and of castings.

Following the meeting in San Antonio, members of the group traveled to Monterrey, N. L., Mexico, where they inspected the facilities of the Instituto de Investigaciones Industriales, a not-for-profit research institution. The Instituto is affiliated with the Instituto Technológico y de Estudios Superiores de Monterrey and with SwRI in San Antonio. Members of the party also toured the steel plant of Hojalata y Lámina, in Monterrey.

Meanwhile Back at the Ranch

A short distance from the heart of San Antonio, up on a rise, lies the great SwRI spread. Until not too long ago the thunder of cattle was the characteristic sound. Today, in addition to the old ranch house are several businesslike laboratories and a modern administration building. Off in a distant corner there is a cattle farm for the work in husbandry. In another spot off yonder are housed 150 baboons for study. And in between at this "brain factory" there are men playing with railroad trains, and "lie detectors" mounted on caterpillars for use in Antarctica to probe the terrain for crevasses.

In 1957, when this reporter visited SwRI for the first time, there was a gate house, the same old ranch house, and some quonset huts were being used as laboratories.

This year SwRI, in August, signed its 1000th Research Agreement initiating engineering studies for a new completion tool for the drilling industry. Gross revenues of $5,080,000 were derived from 228 projects active during the year.

This represents a 15 per cent increase over the previous fiscal year. Contracts with industrial and other nongovernment sources accounted for 53 per cent of the year's activity, as compared with the 48 per cent figure for the previous year. SwRI also is editorial headquarters for the ASME publication *Applied Mechanics Reviews*.

Martin Goland, Mem. ASME, and president of SwRI, in his report to the trustees of the Institute, predicted that within the next decade the nation's R&D budget would double, reaching an annual volume of $24 billion. He called for a national research purpose to channel effectively these funds.

The SwRI president who is head of an NASA committee and consultant to the House Committee on Science and Astronautics said this creative effort must be geared to meet a variety of challenges. In the classical pattern, it must create new wealth to keep our free enterprise economy vigorous. The realities of national defense place enormous emphasis on scientific advance. In the arena of international politics, the prestige of nations is tied to research accomplishment. In fact, those who threaten our way of life have chosen science as a major battleground for the future. However, it is not enough to increase our expenditures. We must be guided by a national research purpose.

Mr Goland said we must adopt a co-ordinated national policy to optimize the effectiveness of our research effort. He stated it was curious to note how slowly improvements are being made along this line.

"What appears to be lacking is co-ordinated leadership on a national basis which will point the way. Thus far generalities have been exchanged and traditional thinking has persisted," Mr. Goland charged. "Let us hope that the next few years will see the emergence of an effective national policy which will incorporate the same creative thinking which is characteristic of science itself."

Mr. Goland said we should consider the possibility of setting up national research institutes organized to accelerate

A specially developed device for nondestructive magnetic testing. High flux density is obtained by passing 300 amp through a 62-turn coil of 4/0 conductor.

research in a particular branch of science. These have been predominant factors in Soviet science and have been utilized in the fields of agriculture, medicine, and nuclear science in the U. S. If such groups are established, he pointed out, we should consider whether they should be an appendage to the university as is presently proposed.

He stated the traditional pattern of the university professor and his group of graduate students is invaluable in areas of fundamental science, but that recently the need for extension of this system has been seen. Among the added advantages to be sought are the greater continuity of the group, the broad team approach of experts skilled in various disciplines, and maintaining the major experimental facilities so essential to modern scientific pursuits. He also said we could consider the private financing of research and perhaps give special tax advantages to industries which sponsor nonproprietary research programs.

Some Current SwRI Investigations

SwRI is investigating various techniques to determine hidden fatigue in materials. Among the methods under investigation are: Ultrasonic attenuation, magnetoabsorption, and magnetic techniques.

The most promising to date are magnetoabsorption and magnetic techniques. The magnetoabsorption studies are still in the basic stage and although considerable differences in energies absorbed has been observed in specimens subjected to experimental stress, the exact relationship to fatigue has not been determined.

Further along is the use of magnetic techniques. Positive identification on a routine laboratory basis is now possible for inclusions and flaws a few mils in diameter and located several mils below the surface.

The ultimate purpose of the research is to assemble basic information from which to design automatic inspection devices.

SwRI now is entering the second phase of a pipe-inspection program. The goal is an automatic means of checking pipe at high speeds through a combination of ultrasonic and magnetic principles.

The SwRI Department of Chemistry and Chemical Engineering is studying the effect of acoustic vibrations to improve heat transfer. This research project is being sponsored by the Office of Saline Water, U. S. Department of the Interior.

The present research program has demonstrated that improvement in water side heat-transfer coefficients can be obtained by the use of acoustic vibrations. At a Reynolds Number of 541 an improvement of 450 per cent was obtained with a frequency of vibration of 42 cps and an amplitude of 0.15 in., according to Irwin Raben, who is directing this study, and his co-worker, Robert Dietert. The experimental unit consisted of a 1-in. pipe which was electrically heated and installed within a 3-in. pipe. Water flowed in the annular passage. The pipe was vibrated in a transverse direction. A summary of the data is presented as follows:

Re (Reynolds No.)	h_o (Heat-Transfer Coefficient Without Vibration)	h_v (Heat-Transfer Coefficient With Vibration)	$\frac{h_v}{h_o} - 1$
541	171	910	4.43
1418	187	707	2.78
5000	225	601	1.67
12340	398	512	0.26
16000	508	549	0.11

The present study also has shown that a definite improvement in steam-condensing coefficients was obtained when condensation takes place on the outside of the tube undergoing transverse vibration. The heat-transfer coefficient was increased 57 per cent at a frequency of 73 cps and an amplitude of 0.2 in. Acoustical vibrations also improve steam-condensing coefficients when condensation occurs in the presence of noncondensables. Preliminary data indicate an improvement of approximately 20 per cent.

Ultrasonic instrumentation to detect latent waves in the metallic ring is measured with

This May Be the Return Ticket

Missile nose-cone materials and other temperature-resistant compounds can be subjected to conditions simulating rocket entry into the atmospheres of the Earth,

Venus, Mars, or Saturn in a high-temperature facility in operation at SwRI.

The same unit can be used to study the effects of heating on vehicles in the vacuum of space or materials under the high temperatures which might result from a nuclear accident.

What It Can Do. The facility is capable of generating the following environments: Temperatures approaching those of the Sun's surface (9800 F); pressures ranging from 0.1 mm Hg to 9 atmospheres applied on the material undergoing test; and any nontoxic gas as an atmosphere.

With modifications, the unit may be used in other type research programs:

1 Development of new high-temperature materials by vacuum deposition, or melting and controlled recrystallization, of high-temperature refractory materials.

2 Development of techniques for high-temperature processing of materials involving the design of specific processing cycles for fast-heat, fast-quench processes;

fatigue. The velocity of ultrasonic surface high accuracy.

e.g., the direct reduction of metallic oxides.

3 Research on the effects of combined environments. A variety of programs could be conducted, such as high thermal flux combined with ionizing radiation, varied chemical environments, etc.

Development and Application. Developed by SwRI under the sponsorship of the National Aeronautics and Space Agency, the unit was originally designed to test materials under extreme thermal flux as encountered in ballistic missile re-entry and to study thermal ablation and heat-exchange phenomena.

Potential utilizations of the facility as presently constructed include such other applications as research investigations into the properties of materials at high temperatures; the development of high-temperature materials through controlled melting and solidification; investigation of heat exchange at high thermal input; the determination of thermal constants of materials; and evaluation of materials for performance under specified combinations of thermal flux and atmosphere.

The facility consists of an arc-imaging furnace which utilizes twin parabolic mirrors to collect the radiation from the arc and focus it on a test specimen.

When a test is being run, air is blown around the arc, and serves to carry away flame, combustion products, and ionized gas layers. As a result, the collecting mirror receives radiation directly and is not obscured by intervening lower-temperature sources.

At the extreme heating rates produced thus far, all solid materials tested melt or vaporize rapidly. Consequently, the duration of a test may be as short as 0.2 seconds, and seldom exceeds 10 seconds. Therefore furnace operation and all measurement and recording operations are automated.

The thermal flux produced (the rate of temperature rise) is in the 50 to 600 cal/cm^2-sec range (185–2230 Btu/ft^2-sec). The specimen is located remotely from the arc and is subjected to thermal radiation only, instead of being immersed in the arc or in a plasma jet in which aerodynamic and electromagnetic forces are present and the specimen is immersed in a highly ionized medium.

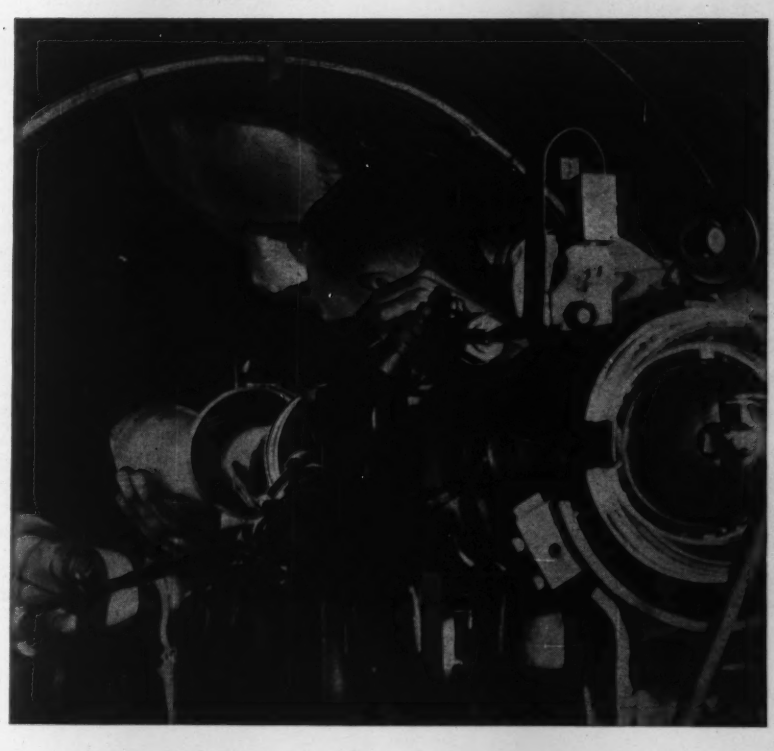
The exact temperature generated by the arc is highly difficult to determine. However, when it is computed on a heat-balance basis, of 500 cal/cm^2-sec, it corresponds to an effective temperature of 7820 F at the specimen. Because of losses in the optical collecting system, the temperature at the arc must be higher, of the order of 9800 F, which is near the surface temperature of the sun.

Specimens up to $^7/_8$-in. diam and 2 in. in length can be tested at the maximum flux input. With minor modifications, the system can accommodate specimens up to approximately one foot in length.

During specimen irradiation, surface reactions, ablation phenomena, and other high flux phenomena must be recorded. A quartz window in the furnace access door permits observation of the specimen. A lens and mirror system is used to direct emitted radiation from the specimen surface to a spectrograph. A Fastax motion-picture camera is used to take high-speed color photographs of specimens during irradiation.

The system is equipped with a 500-kw continuous rating substation and rectifier with overload ratings up to nine times this power for short duration tests. With this versatile research tool, research into the behavior of materials both at high temperatures and at high thermal flux rates, and the development of engineering criteria can form the basis for a variety of new materials and processes.

Parabolic mirror installed at rear of unit focuses radiation directly onto the specimen. Reflection shows engineer at work.

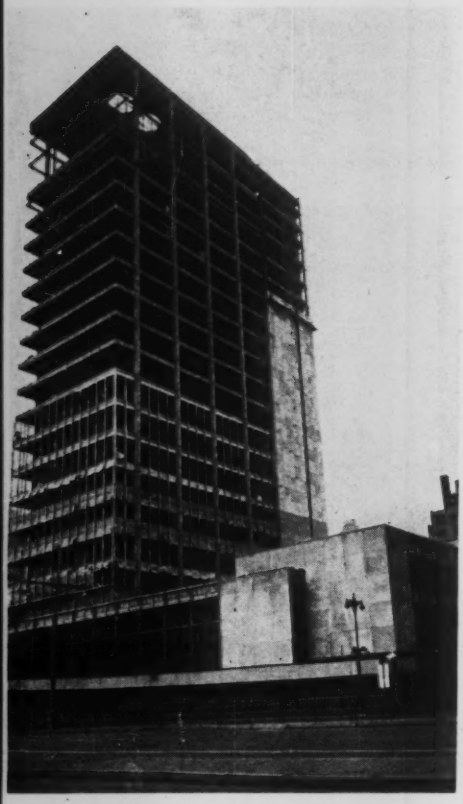


United Engineering Center

ASME on the Move

No NEW sections joined the 100 per cent club last month, but things are stirring. The Gulf Coast Section continued its good work and now has less than $411 to go. Nebraska has asked for more pledge cards and is drawing a bead on the $833 they need. Boston, under the leadership of T. N. Graser, is rechecking its special-gifts canvass. San Francisco, while it has a long way to go, picked up over $800 last month, and no doubt will do better as the end of the tax year draws near. It is pertinent to the situation in San Francisco and Los Angeles to note that the Civils went over the top at both locations. Their quotas were almost identical to ours in these two cities.

New United Engineering Center is fast losing appearance of a skeleton. View shows Center on November 3.



D. E. Marlowe, Vice-President of Region III, is working closely with Philadelphia, Baltimore, and Washington. In any case, the entire campaign is being reactivated, materially to improve the per cent of quota achieved. In Philadelphia, a special team of 50 solicitors will personally contact a selected list of prospective donors. T. S. Fetter, by means of this intensive effort during the last weeks of this tax year, hopes to achieve a good share of the balance of his quota. Anthracite-Lehigh Valley added 4.6 points to its per cent of quota achieved, and should go over the top before the next report. North Texas section, struggling along at 25 per cent of quota received an unexpected boost in the form of a gift from Miss Jane M. Willis, a student member at SMU. Other members of this Section please take note.

The value of leadership in a campaign of this sort has been demonstrated by E. W. Allardt in Region V. Not only is the Region over 100 per cent, but seven of the sections have exceeded their quota by substantial margins, and five others are within striking distance of this goal. There is no substitute for effective leadership at the regional and section levels. We are looking forward with interest to the report of each Vice-President at the Winter Annual Meeting on his plans for meeting the ASME United Engineering Center quota in his region.

Several members of the 100 per cent club are still pressing forward. Detroit and Metropolitan both registered gains last month. It is evident that solicitation in these areas acquired considerable momentum, and results will be evident for weeks to come.

Statistics must be interpreted to be of value. On the average, less than 33 members out of every 100 have contributed. Those sections with low per cent of quota achieved almost invariably have low member participation. There is the possibility that the majority of the 30,000 members who have not given have never been contacted personally. Those sections using teams of solicitors for personal solicitation report higher member participation, and individual gifts well above the average.

In a project of this kind, there is not a substitute for the simple person-to-person request, "Mr. Engineer, we want your financial support for this project, and please be generous."

▼ Your Section's Score as of Oct. 28, 1960

Per Cent of Quota	SHORT OF QUOTA Section	Dollars Short of Quota
97.8	Erie	97
91.1	Sabine	208
90.2	North Alabama-Mississippi	230
78.0	Gulf Coast	411
87.0	Rock River Valley	514
83.1	Iowa-Illinois	655
68.6	New London	717
84.7	Piedmont-Carolina	730
91.7	Anthracite-Lehigh Valley	731
95.5	Cleveland	735
81.0	Mid-Hudson	738
71.5	Nebraska	833
93.9	Milwaukee	869
90.6	Fairfield County	880
27.6	Paducah	970
53.6	Utah	985
85.2	Rochester	1,007
66.4	Central Savannah River Area	1,023
40.2	Miami	1,041
9.2	Palm Beach	1,090
55.2	Central Michigan	1,119
86.3	Minnesota	1,215
42.4	Greenville	1,232
70.9	Susquehanna	1,233
42.5	Central Kansas	1,264
47.5	Idaho-Montana	1,272
29.6	Savannah	1,324
40.4	Mexico	1,336
82.8	Columbus	1,355
32.5	Mohawk Valley	1,403
57.2	Eastern Virginia	1,404
67.0	Toledo	1,504
84.5	Kansas City	1,524
0.9	North East Florida	1,585
65.0	Syracuse	1,675
92.9	Pittsburgh	1,718
43.4	Oregon	1,790
56.0	New Haven	1,823
	MORE THAN $2000	
53.1	Arizona	2,034
71.1	Akron	2,051
62.8	East Tennessee	2,083
79.7	Delaware	2,093
22.1	Central Pennsylvania	2,150
50.5	Western Massachusetts	2,336
24.8	Eastern North Carolina	2,360
56.8	Central Illinois	2,557
18.0	Central Pennsylvania	2,642
24.4	Virginia	2,919
18.3	St. Joseph Valley	3,054
23.7	Louisville	3,127
34.1	Florida	3,139
45.2	New Mexico	3,377
59.5	Western Washington	3,912
14.5	Northern New England	4,310
17.6	Chattanooga	4,584
63.7	Baltimore	4,836
30.9	Rocky Mountain	4,974
	MORE THAN $5000	
34.8	Buffalo	5,095
52.7	St. Louis	5,317
24.0	New Orleans	6,309
35.6	Mid-Continent	6,802
34.2	Ontario	6,901
37.1	Hartford	7,529
53.3	Mid-Jersey	7,818
42.4	South Texas	8,773
25.3	North Texas	9,340
34.8	Washington, D. C.	9,600
61.2	Boston	11,528
70.1	Chicago	12,914
52.4	San Francisco	14,629
55.1	Philadelphia	19,381
29.8	Los Angeles	35,868

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Success of First ASME Rubber and Plastics Conference Points Way to a Series in Future

THE FIRST conference of the Rubber and Plastics Division of The American Society of Mechanical Engineers held at the Hotel Lawrence, Erie, Pa., Oct. 9–11, 1960, was successful and indicates the need and desire for similar meetings in the future, reports R. N. Peterson.

He further pointed out that the Division in the past has had sessions only at the Annual Meeting of the Society, but the enthusiasm and response at the Erie meeting should point the way to other Rubber and Plastics Division Conferences in the future. Mr. Peterson, Mem. ASME, is assistant technical superintendent, Polychrom Department of E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.

His report of the meeting continues as follows:

Registration. Approximately 200 were registered. They included material suppliers, processors, original equipment manufacturers, and end users. Interest was divided fairly equally in both rubber and plastics sections. It is interesting that the ratio of member to nonmember was about 1:1; normally, the ratio is about 4:1. Successful meetings of this type should bring new members into the Society interested in this rapidly growing field.

A Sad Note. One note of extreme sadness distressed all conference members. Prof. John E. Rutzler, Jr., of Case Institute of Technology, had a fatal heart attack after an excellent presentation of an interesting paper. Professor Rutzler represented to all present the keen orderly mind searching for new knowledge. It is noteworthy that his last remark in answer to a question was, "I have to learn more about this new technique." We all extend to Mrs. Rutzler and John, III, our deepest expression of sympathy.

What They Learned. The majority of the papers emphasized that rubbers and plastics are engineering materials and that structural and mechanical applications can be designed if the viscoelastic characteristics of the materials are considered.

The increasing use of fabrics in structures received considerable attention in both the rubber and plastics sessions. The biaxial-stress problems in fabric structures in general as well as specific applications were discussed. The development of flexible barges for lightweight liquid cargoes offers a new method of transport. Air structures designed using aerodynamic principles are finding military and commercial uses.

Apparatus for developing design data with consideration to time, temperature, stress level, and environment were described. Attention was drawn to new apparatus and technique which permit measurement of electrical and mechanical behavior of plastic materials and the relation of these to the chemical nature of the plastic. New apparatus for measuring and the stress-strain relationships in cross-linked polyethylene were described.

The characteristics of a viscoelastic material for incorporation into highly damped structures were outlined. New elastomeric compounds were described which effectively suppress noise and vibrational energy resonating in plates and structures. The use of elastomers as a bearing material for structures where damping vibration is essential were discussed.

A brief but complete summary of the techniques and some of the applications for thermoforming plastics should be a good reference. A comprehensive review of engineering developments in the plastics industry should aid the mechanical engineer.

The Erie Engineering Societies Council and the Erie Section of the ASME are to be congratulated on the success of this first annual meeting.

Availability List—Rubber and Plastics Conference

THE papers in this list are available in separate copy form until Aug. 1, 1961. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 50 cents each to members; $1 to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

60—RP-1 Reinforced Plastic Films as an Engineering Material, by J. Bjorksten and W. Cameron

60—RP-2 Air Structures—A New Concept in Engineering Design, by W. W. Bird

60—RP-3 Presses in the Rubber and Plastics Industry, by E. Perlberg

60—RP-4 Planning and Design Requirements for the Handling of Collapsible Rubber Containers, by N. H. Brown, Jr.

60—RP-5 "Dracone" Flexible Barges—Some Problems of Design, Materials, and Construction, by H. W. Hall

60—RP-6 Elastomeric Gyro Suspensions, by J. T. Gwinn, Jr.

60—RP-7 Automated Tire-Curing Room, by L. E. Soderquist

60—RP-8 An Introduction to Biaxial-Stress Problems in Fabric Structures, by A. D. Topping

60—RP-9 Obtaining Stress-Per-Cent Compression Diagrams of Foamed Plastics at High Rates of Compression, by R. C. Dove, W. E. Baker, and C. D. Beaman

60—RP-10 A New Viscoelastic Compound for the Suppression of Noise and Vibration in Structures, by C. H. Peterson

60—RP-11 Fillers and Stresses in an Epoxy Resin, by J. E. Rutzler, Jr., and L. C. Feinstein

60—RP-12 Elastomers as a Structural Material, by E. E. Thielker

60—RP-13 Principles of Processing Liquid Urethane Elastomers, by J. A. Hanzel

60—RP-14 Stress-Strain Relations in Cross-Linked Polyethylene, by I. L. Hopkins and R. P. Wentz

60—RP-15 Design Strength Data and Calculations on Thermoplastic, by W. D. Harris

60—RP-16 Novel Designs in Sandwich Structures, by A. C. Marshall

60—RP-17 Magnetic Rubber, a New and Useful Material, by R. J. Webster

60—RP-18 Plastic Films Continuously Laminated to Rigid and Semi-Rigid Substrates, by D. M. Wilkinson

60—RP-19 Elastomers Applied to Structural Damping, by B. W. Campbell

60—RP-20 Automotive Engine-Mount Design, by A. L. Everitt

60—RP-21 The Analog Computer and Its Application in the Rubber and Plastics Industry, by A. Katz and P. Berthiaume

ASME-ASLE Lubrication Conference Concentrates on Lubricants and Machinery

For the seventh year, the Lubrication Division of The American Society of Mechanical Engineers joined with the American Society of Lubrication Engineers in holding its annual conference. The conference, held in co-operation with the Boston Sections of both societies, took place at the Statler Hilton hotel in Boston, Mass., Oct 17–19, 1960.

More than 400 engineers—including several speakers from the United Kingdom Atomic Energy Authority—all specialists in lubrication, gathered at the conference where 30 technical papers were presented and discussed. The papers furnished dramatic proof of the growing complexity of engineering problems. Some of the questions being debated: How to lubricate parts so cold they operate in a sea of liquid air; how to lubricate parts as hot as the superheated atmosphere of an experimental space rocket or an atomic reactor.

New Lubricants. One answer is new kinds of lubricants, departures from the conventional oil and grease, special chemicals and even gases such as carbon dioxide and plain air. It comes as a shock to the old-time engineer to learn that air has a measureable viscosity. A number of the papers took up the calculation of the performance of gas bearings.

Machinery. Another field of current interest lies in machinery that must operate unattended, usually in remote locations. An example is the unattended pumping unit for cross-country pipelines (see "Gas Turbines in the Arabian Desert," Mechanical Engineering, April, 1958, pp. 81–84). Among the remote regions in which machinery must operate unattended is outer space.

Machines in atomic plants present special problems, not only because of high temperatures, but because high radiation levels prevent maintenance workers from reaching them. Radiation also may cause lubricants to break down.

Who Said It. Speakers on gas lubrication included representatives of IBM Research Laboratories, The Franklin Institute, Rolls Royce, Ltd., Carnegie Institute of Technology, Westinghouse Research Laboratories, Jet Propulsion Laboratory, UKAEA, and Massachusetts Institute of Technology. In some gas-lubricated devices, a film of compressed air is injected between the surfaces to permit them to ride on a film of air. A problem arises in the starting and stopping of such bearings, when they operated briefly under dry-friction conditions.

Other institutions represented by papers at the conference were: University of Tennessee, Tube Investments Research Laboratories (Cambridge, England), Lewis Research Center (Cleveland, Ohio), Caterpillar Tractor Company, Technische Hochschule (Munich, Germany), Shell Development Company, General Motors Research Laboratories, The Cryogenic Engineering Laboratory of the National Bureau of Standards, Esso Research and Engineering, General Electric, Texaco Research Center (Beacon, N. Y.), Clevite Corporation (Cleveland, Ohio), Rensselaer Polytechnic Institute, and Autonetics, Inc. (Downey, Calif.).

Availability List—ASME-ASLE Lubrication Conference

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60—Lub-1 Extension of the Conducting Sheet Analogy to Externally Pressurized Gas Bearings, by L. Licht

60—Lub-2 An Assessment of the Value of Theory in Predicting Gas-Bearing Performance, by S. Cooper

60—Lub-3 Solution of Reynolds Equation for Arbitrarily Loaded Journal Bearings, by O. Pinkus

60—Lub-4 Lubrication at High Temperature With Vapor-Deposited Surface Coatings, by D. J. Baldwin and G. W. Rowe

60—Lub-5 Grease Lubrication Studies With Plain Journal Bearings, by L. J. Bradford, E. M. Barber, and J. R. Muenger

60—Lub-6 A Theoretical Investigation of Pressure Depression in Externally Pressurized Gas-Lubricated Circular Thrust Bearings, by Haruo Mori

60—Lub-7 The Volume of Stressed Material Involved in the Rolling of a Ball, by R. C. Drutowski

60—Lub-8 Gear and Bearing Lubrication in Extreme Environments With Polyphenyl Ethers, by J. B. Accinelli, V. N. Borsoff, W. W. Kerlin, and S. J. Beaubien

60—Lub-9 An Improved Analytical Solution for Self-Acting, Gas-Lubricated Journal Bearings of Finite Length, by J. S. Ausman

60—Lub-10 Performance of Elastic, Centrally Pivoted, Sector, Thrust-Bearing Pads—Part 1

60—Lub-11 Consideration of the Starting of Gas-Lubricated Bearings, by M. Wildmann

60—Lub-12 The Effect of the Method of Compensation on Hydrostatic Bearing Stiffness, by S. B. Malanoski and A. M. Loeb

60—Lub-13 Perturbation Solutions for Gas-Lubricating Films, by W. A. Gross and E. C. Zachmanoglou

60—Lub-14 Adsorption of Polar Organic Molecules on Machined Metal Surfaces and Properties of the Resulting Surface Films, by H. A. Smith and R. L. Bennett

23rd Joint Solid Fuels Conference Predicts—Future of Coal Is Not Black

"While the future of coal may exactly not be glowingly roseate, at least prospects have not been brighter in many years," according to Stephen F. Dunn, president of the National Coal Association. The statement was made in a luncheon address at the 23rd annual Joint Solid Fuels Conference, held at the Daniel Boone Hotel, Charleston, W. Va., Oct. 24–25, 1960. More than 200 attended the conference sponsored by the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the Society of Mining Engineers of the American Institute of Mining, Metallurgical, and Petroleum Engineers in co-operation with the ASME West Virginia Section.

Mr. Dunn reviewed the recent history of the coal industry and summarized the activities of the National Coal Association which in total, he said, "are going a long way to improve the industry's economic position."

Thompson Chandler of Union Carbide Corporation, past Vice-President of ASME Region V, presided at the luncheon.

The Governor of West Virginia Said. His Excellency Cecil H. Underwood, Governor of West Virginia, delivered the Banquet Address on "West Virginia Coal Resources." He spoke of the preliminary test-loop research on components for a coal-gasification process which would use gas-cooled nuclear reactors to produce the process heat required (Mechanical Engineering, August, 1960, p. 72). The work is being done at the Morgantown, W. Va., Coal-Research Center of the U. S. Bureau of Mines in co-operation with the Atomic Energy Commission. The Governor indicated the possibility that a pilot nuclear-gasification plant may be built in West Virginia.

Honors. The Percy Nicholls Award for notable scientific or industrial achievement in the field of solid fuels was presented to Carl Eugene Lesher by R. B. Engdahl of Battelle Memorial Institute, Men. ASME and chairman of the award committee. The award was made in recognition of Mr. Lesher's outstanding achievement in the improved utilization of bituminous coal which has resulted in the operation of the largest plant in America for the low-temperature carbonization of coal.

W. T. Reid, of Battelle Memorial Institute, Mem. ASME and chairman of the ASME Fuels Division, presided at the Banquet. The Guildaires of the Charleston Light Opera Guild provided entertainment.

Technical Sound. Nine technical papers were presented at the conference, ranging from "Our Knowledge of the Current Status of Underground Gasification in Russia" and research on fuels and combustion problems to mechanical mining methods and the coal industry's management and marketing problems.

One of the four papers preprinted by ASME was a ten-year study of the fuel-consumption experience of electric utilities. This showed a steady increase in the use of coal each year except 1958, and a 154.2 per cent increase for the decade 1949–1959. During the same period oil increased only 41.4 per cent but natural gas gained 224 per cent. In relative importance coal has remained fairly consistent, accounting for about two thirds of the fuel used, while oil decreased steadily and natural gas gained in about the same degree that oil lost. Changes in fuel utilization by the major geographical regions and improvements in fuel efficiency were also included in the comprehensive study made by National Coal Association economists.

An hypothesis that inflammable limits would be reached more quickly with high-volatile coals than with low-volatile coals resulted from studies on the combustion of pulverized coal. The authors state that "the complexity of the combustion problem raises numerous questions for which answers are essential before a comprehensive understanding of the phenomena involved can be given. . . . The hypothesis presented, although simplified, would appear to help explain some of the more common phenomena noted, and at the same time raises many questions."

One of the other preprinted papers presents a system for controlling the combustion of two solid fuels in a steam-generating unit.

The author of another paper stated that "far too many plants are passing up large savings to be obtained by burning coal." Methods of coping with the extra handling and capital investment required for coal are suggested.

C. E. Lesher receives Percy Nicholls Award at 23rd annual Joint Solid Fuels Conference, Charleston, W. Va., at the banquet on Oct. 24, 1960. **Left to right** are: D. C. Calhoun, R. B. Engdahl, H. O. Zimmerman, W. T. Reid, and Mr. Lesher.

The Hon. C. H. Underwood, Governor of the State of West Virginia addresses the banquet guests at the Solid Fuels Conference

Availability List—ASME-AIME Fuels Conference

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60—Fu-1 A Decade of Electric-Utility-Fuel Experience, by M. E. Robinson and W. L. Kurtz

60—Fu-2—A Concept of Combustion Control for Firing Two Solid Fuels, by C. E. Rodenburg

60—Fu-3 The Influence of Volatile Matter on the Combustion of Pulverized Coal, by J. F. Mullen and G. Gould

60—Fu-4 New Concepts—Coal From Mine to Industrial Boilers, by C. E. Day, Jr.

Fourth Biennial ASME-EIC Engineering Education Conference Held in Montreal

IN 1954 there was inaugurated a series of conferences co-sponsored by The American Society of Mechanical Engineers and the Engineering Institute of Canada. The first, at Clarkson College of Technology, was followed by another, in 1956, at the University of Western Ontario, and then by a third on the campus at the University of Michigan, in 1958. On October 5–6 of this year, immediately following the Annual Meeting of ECPD (see pp. 100–101 in this issue) in the same city, Montreal, Que., Canada, the fourth such event was hosted by two great institutions of higher learning, Ecole Polytechnique and McGill University. The theme—The Engineer in 2000 A.D.: How Much Science in His Education?—was conceived by the planning committee as one to attract the keen interest of educators (those fabricators of semifinished human products) as well as industrialists, the users and refiners of engineering graduates. It was anticipated that both of these groups, recognizing their many responsibilities, would relish the opportunity to gaze in a crystal ball to view "the shape of things to come." So it was, for more than 130 interested individuals responded from both sides of the border for a full two days of deliberations in a climate of opinion conducive to profound consideration of the subject.

After words of welcome from D. L. Mordell, Mem. ASME, Dean of Engineering at McGill University and by Director H. Gaudefroy of Ecole Polytechnique (the latter spoke in French, the language used throughout the many departments of that school) the first session began under the Chairmanship of Dean Edward McHugh, Mem. ASME, of Clarkson College of Technology.

The Engineer 50 Years Hence. Four speakers presented their concepts of the engineer in a society 50 years hence—an individual who, as a consequence of a continued explosion of science and technology, will be required to be more completely educated and more adequately prepared for life in 2000 A.D. than those who graduated from engineering schools in the first half of the twentieth century.

From Dr. D. M. Meyers, Dean of Engineering, University of Vancouver, came the following queries: "Will there be a Profession of Engineering in 2000 A.D.? If so, how will it differ from the present? Will engineers stay in their watertight compartments or will they assume increasing responsibility for the consequence of their work?"

Dr. Paul F. Chenea, Mem. ASME, head, Mechanical Engineering Department, Purdue University, initiated his remarks by commenting, "The engineer of 2000 A.D. will still be the doer, the problem solver, and the decision maker for technical matters in industry. This is not to say that he will do these things in precisely the same way he has done them in the past or even in 1960. Primarily, however, the heart of engineering will still be design, although the kinds of devices and processes which the engineer will design in the last 40 per cent of the twentieth century will become more and more exotic from our present viewpoint and will encompass greater and greater complexity."

In pursuance of the same view beyond the horizon, R. S. Sproule, Mem. ASME, manager, Hydraulic Division, Dominion Engineering Company, asked, "What will industry and society require of the engineer in 2000? Technically, all the different types of mechanical engineers require different skills, and any one type requires different skills in different organizations. Industry cannot expect to receive trained engineers from any outside source. At best it can get men who are easy to train. I foresee no great change by 2000. What we can hope for, and here there is a great scope and hope, for improvement by 2000, is to get men with an engineering attitude—a mania for fact, awareness of time, and knowledge of the importance of money even outside of salary. Ingenuity, initiative, and talent for teamwork, not necessarily in the same individual, will be at a premium."

Aimed at the Appliant Scientist—A New Member of the Engineering Team, Dr. G. N. Patterson, director, Institute of Aerophysics, University of Toronto, said in part, "In order to bring the engineer of 2000 A.D. into focus from at least one point of view, the modern position of the new field of aerospace engineering is considered with a view to some extrapolation into the future of the branch of the profession." And speaking of the demands for new materials he said further, "The so-called exotic materials of the past have become the new engineering materials of today. Exceptional reliability and compactness applied to ever more complex systems are the modern design requirements in electronics and may lead to the micro-miniature components of the future. The so-called vacuum of space is now known to contain participles which must be considered at satellite speeds and the new subject of free molecule aerodynamics is now under development. In all these activities the partnership of the engineer with the engineering scientist becomes increasingly important."

What Will Be Required of Engineers. At the luncheon of the first day of the conference, the speaker was ASME President Walker L. Cisler. He presented an image of what the world of 2000 A.D. will require of the engineer—the demands of Society in which he lives and how he will be expected to serve mankind far beyond any concept as it exists today. Because of his unique experience and service for many years,

IRD Takes New Name—Automatic Control

IN ACCORDANCE with the request expressed at the 1959 ASME IRD Membership Meeting, a new name has been selected for the Division, and approved at the Professional Divisions Planning Committee Meeting, Oct. 10, 1960. The new designation title will be Automatic Control Division. This name was selected as the one which will be most meaningful to engineers and laymen.

as an "engineering statesman," representing his country at home and abroad, Mr. Cisler was in a position to speak with authority on significant facets relating to the theme of the meeting.

The second day was devoted to a consideration of the needs of education for 2000 A.D., when the panel discussion was guided by Chairman L. A. Duchastel, personnel manager, Shawinigan Water and Power Company.

Educating the 2000 A.D. Engineer. The first panelist was Dr. R. G. Folsom, Fellow ASME, President of Rensselaer Polytechnic Institute, whose remarks might well be epitomized by reference to a portion of his closing remarks, "The student of the future will continue to participate in an engineering program that will include both classroom and laboratory, but this program will be designed to develop:

1 The student's ability to consider such items as available instrumentation, available personnel, the costs involved, the accuracy of results desired, the variables that must be controlled or considered.

2 The student's ability to handle and understand engineering instrumentation and equipment.

3 The ability to analyze accurately the difference between theoretical and real conditions.

4 A continuing curiosity and a mastery of the new tools that are being developed to help solve engineering problems."

Dr. E. W. R. Steacie, president, National Research Council (Canada), describing himself as an outsider, presented his thoughts about types and numbers of engineers in 2000 A.D. and commented, "The difficulties in educating engineers stem from the broad range of occupations in which the graduate finds himself. The real profession of engineering involving practice, operation, design, development, and research on the one hand, and the nonprofessional activities such as administration, sales, and the like.

"Engineering education thus possesses much more complexity than education in science, and also is complicated by the undesirable modern emphasis on legally defined professional qualification. Basically the difficulty is that an attempt is being made to educate students with widely divergent motives under the same umbrella."

Another panelist, Dr. Dana Young, Mem. ASME, professor of Civil Engineering, Yale University, referring to some of the problems to be faced in the development of appropriate engineering educational programs in the years ahead said, "A second serious problem is that of the over-all pattern of engineering education. Currently, the predominant pattern in the U. S. A. is that of a four-year undergraduate program in a specific engineering field for all would-be engineers, followed by graduate study at the master's level for some and at the doctoral level for a very few. And it should be noted that the doctoral study is primarily directed along the lines of basic engineering science and research therein.

"It is this pattern that may well be changed in the era ahead. Briefly, the changes that I envision are as follows: The four-year bachelor's program will be generally similar for all engineering students without differention into the classical fields of Civil, Chemical, Electrical, Mechanical, Metallurgical, and so on. It will include a strong grounding in the sciences, mathematics, and above all, in the principles and concepts of engineering analysis, synthesis, and design. The four-year program would not be considered a professional program, nor would it be considered a terminal program for those who wished to become professional engineers.

"True professional training would be left for advanced study after completion of the bachelor's program. This advanced training would probably require about three years. There should be a central core of subject matter required that is essential for all professional engineers and this will probably be subjected to accreditation by an appropriate agency. Beyond this central core of studies there should be provision for emphasis on one or more of the many areas of functions of engineering. This may be areas oriented such as toward structures, materials, power, electronics, or chemical processes. Or it may be functionally oriented such as toward research, design, or management."

Finally, M. P. O'Brien, Fellow ASME, dean-emeritus, College of Engineering, University of California, Berkeley, Calif., an educator who has been actively engaged in industrial practice throughout his professional career closed his prepared remarks with the following: "Emphasis on science, mathematics, and the social sciences and humanities has been the central theme in the changed mode in engineering education since the last world war. These changes are good and were overdue. However, there has been a concurrent de-emphasis of the professional aspects—principally in the almost complete elimination of design both in the curriculum and in the interests and experience of the faculty. The proper major objective is simply stated; prepare the graduates for the practice of engineering. The test of success is the degree to which the graduates do acquire an absorbing interest in designing and building engineering equipment and works which fulfill their objectives—and at a cost which will yield a profit to the client, public or private. There are other important but secondary objectives which every engineering school should pursue and control, but failure to fulfill this major objective successfully places a school in some category other than engineering, no matter how distinguished it may become in other respects.

"The Western World will need desperately the highest calibre of engineering over the next century. It is the privilege and the responsibility of the engineering schools to serve this end."

With these and other contributions by those who have been quoted, discussions

ASME President W. L. Cisler addresses luncheon meeting at McGill University on the opening day of the ASME-EIC conference. Immediately to his left are: Dean D. L. Mordell of McGill's engineering faculty (smoking the pipe) and EIC President George McK. Dick, Mem. ASME. Others at the head table are unidentified.

were initiated among the many interested participants—deliberations which extended for beyond the bounds of the time schedule. It was the concensus of all that there had been opened new avenues of approach to the multishaped problem posed by the statement "The Needs of Education for 2000 A.D." and that as a result of this conference useful concepts had been delineated to serve well those who must match this challenge with resolute performance in the years ahead.

ASME CODES AND STANDARDS WORKSHOP

Interpretations of 1955 Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinions of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1—1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Cases No. N-3, N-4, and N-9 are published herewith as an interim action of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case N-3 Proposed Case on Screwed Connections.

Inquiry: May screwed connections in which threads provide the only seal be used in nuclear piping systems?

Reply: It is the opinion of the Committee that screwed connections in which threads provide the only seal shall not be permitted in nuclear piping systems.

Case N-4 Proposed Case on Paragraph of Section 1

Inquiry: Sec. 1 Par. 121C limits the temperature of the hydrostatic media to 100 F maximum. May this limit be exceeded on nuclear piping systems?

Reply: It is the opinion of the Committee that, pending revision of Sec. 1, the 100 F maximum may be exceeded.

Case N-9 (Reopened) Centrifugally Cast Austenitic Steel Pipe for Nuclear Service

Inquiry: Under what conditions may centrifugally cast austenitic stainless steel pipe be used within the scope of Section 1 of the Code for Pressure Piping for nuclear service?

Reply: It is the opinion of the Committee that the intent of the Code will be satisfied provided the following conditions are met:

1 Chemistry and Mechanical Property Requirements:

(*a*) The chemistry and tensile requirements shall be as given in ASTM A-351. These shall be established from a sample ring cut from one end of each length of pipe, using the testing procedure given in ASTM Specification A-370.

(*b*) The bending properties shall be established as required by ASTM A-376, paragraphs 10 and 11.

2 Finish: The inside and outside surfaces shall be finish machined.

The material shall have a finish of 250 micro-in. RMS of 225 micro-in. AA or better.

3 Testing:

(*a*) Pressure Test: Each length of pipe shall be given a pressure test and shall show no leaks with the test pressure held for a period of 30 min. per in. of wall thickness. The test pressure shall be at least 1.5 times the rated pressure of the pipe at room temperature, except that the stress developed at the test pressure shall not exceed 90 per cent of the specified minimum yield strength based on the actual wall thickness.

(*b*) Surface Inspection—Fluid Penetrant: In addition to visual inspection all surfaces of each length shall be inspected by a fluid penetrant method. The following standards of acceptance shall be met:

All linear discontinuities and aligned penetrant indications revealed by the test shall be removed. Aligned penetrant indications are those in which the average of the center-to-center distances between any one indication and the two adjacent indications in any straight line is less than $^3/_{16}$ of an in.

All other discontinuities revealed on the surface need not be removed unless the discontinuities are also revealed by radiography, in which case the pertinent radiographic specification shall apply.

(*c*) Radiography: Each length of pipe shall be completely radiographed in accordance with ASTM E-94 and shall meet the requirements of ASTM E-71 for Class 2 quality castings.

4 Repair of Defects:

Defects disclosed by inspection and testing may be repaired by welding under the following conditions:

(*a*) Defects shall be removed to sound metal and the surface of the cavity rendered clean.

(*b*) Repair welding shall be done using procedures and operators that have been qualified in accordance with the requirements of ASTM A-376.

(*c*) All repair welds shall be examined by the same procedures and to the same standards as the original cast material.

(*d*) If the material had been heat-treated before making the repair weld, the length shall be reheat-treated.

5. Heat Treatment:

Heat-treatment shall consist of 1950 F minimum metal temperature and shall be cooled in air or liquid medium at a rapid rate.

6. Requirements after Hot-Forming Operations:

Pipe sections that have been subjected to hot-forming operations such as bending, swagging, forging, van-stoning, and similar forming operations shall be reheat-treated in accordance with paragraph five, and fluid penetrant tested.

7 Records:

(*a*) Test Reports: Certified test reports shall give the results of the chemical and tensile properties, and shall specifically indicate that each of the other test requirements in this Case have been met. In the event that the inspector did not witness the removal and repair welding of any defects, the test report shall contain a statement as to the number, approximate extent, and location of such repairs.

(*b*) All radiographs of original material and repaired areas shall be kept for a period of three years and shall be available to the inspector at all times.

8 Retests:

If the results of any chemical or mechanical tests do not conform to the requirements, retests shall be made on additional ring samples of double the original number, each of which conform to the requirements as specified.

9 Special Requirements:

It shall be the responsibility of the designer to require any or all of the following where service conditions or welding requirements warrant and when so specified become a requirement of this Case.

(*a*) Where gaseous products of nuclear fission are anticipated, mass spectrometer or other gaseous leakage tests shall be specified.

(*b*) Where cold-forming or hot-forming are to be considered, ductility shall be compatible with the type of forming.

10 Allowable Stress Values:

The maximum allowable stress for use under this Case shall be as given in the table.

Maximum Allowable Stress Values in Tension, Psi

ASTM A351 grade Spec min tensile Temperature	CF8 700000	CF8M 700000	CF8C 700000	CH20 700000	CK20 65000
− 20 to + 100	17500	17500	17500	17500	16250
200	15700	16900	17000	16100	15300
300	14250	16500	15600	15150	14900
400	13100	16300	14200	14600	14600
500	12200	15900	13000	14550	14550
600	11700	15350	12200	14450	14450
650	11500	15000	11900	14400	14400
700	11300	14700	11700	14350	14350
750	11100	14350	11600	14300	14300
800	10900	14000	11500	14150	14150
850	10650	13500	11350	13900	13900
900	10400	13000	11200	13500	13500
950	10100	12350	11100	12500	12500
1000	9850	11700	11000	10500	11000
1050	9600	10600	10900	8500	9750

Note: These stress values are based on a casting quality factor of 1.00.

ASME COMING EVENTS

November 27–December 2
ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

March 5–9, 1961
ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D.C.

March 12–15, 1961
ASME Aviation Conference, Statler Hilton Hotel, Los Angeles, Calif.

March 16–17, 1961
ASME Textile Engineering Conference, Clemson College, Clemson, S.C.

April 6–7, 1961
ASME-SAM Management Engineering Conference, Statler Hilton Hotel, New York, N. Y.

April 9–13, 1961
ASME Oil and Gas Power Conference and Exhibit, Jung Hotel, New Orleans, La.

April 10–11, 1961
ASME Maintenance and Plant Engineering Conference, Bancroft Hotel, Worcester, Mass.

April 20–21, 1961
ASME-AIEE Railroad Conference, Sir Francis Drake Hotel, San Francisco, Calif.

April 23–26, 1961
ASME Metals Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

May 7–10, 1961
ASME-EIC Hydraulic Conference, Queen Elizabeth Hotel, Montreal, Que., Canada.

May 8–9, 1961
Lubrication Symposium, Deauville Hotel, Miami Beach, Fla.

May 10–12, 1961
ASME Production Engineering Conference, Royal York Hotel, Toronto, Ont., Canada

May 22–25, 1961
ASME Design Engineering Conference and Exhibit, Cobo Hall, Detroit, Mich.

June 11–14, 1961
ASME Summer Annual Meeting, Statler Hilton Hotel, Los Angeles, Calif.

June 14–16, 1961
ASME Applied Mechanics Conference, Illinois Institute of Technology, Chicago, Ill.

August 28–September 1, 1961
Second International Heat-Transfer Conference, University of Colorado, Boulder, Colo.

September 14–15, 1961
ASME-AIEE Engineering Management Conference, Hotel Roosevelt, New York, N. Y.

September 24–27, 1961
ASME-AIEE National Power Conference, St. Francis Hotel, San Francisco, Calif.

September 24–27, 1961
ASME Petroleum Mechanical Engineering Conference, Muehlebach Hotel, Kansas City, Mo.

October 4–6, 1961
ASME Process Industries Conference, Shamrock Hilton Hotel, Houston, Texas

October 17–19, 1961
ASME-ASLE Lubrication Conference, Morrison Hotel, Chicago, Ill.

November 26–December 1, 1961
ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(*For Meeting of Other Societies, see page 108.*)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or Division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price to nonmembers, 50 cents; to ASME members, free. Also available on request is a "Schedule of Program Planning Dates for Meetings and Publication Deadline Dates." Ask for Form M&P 1315.

Freeman Fellowship for Academic Year 1961–1962

APPLICATIONS for the Freeman Fellowship are now being accepted for the academic year 1961–1962 and can be submitted any time before March 1, 1961. Members of The American Society of Mechanical Engineers in the U. S. A. and Canada and the American Society of Civil Engineers are eligible.

Each applicant must submit a detailed prospectus of his program covering a period of at least nine months, and must furnish evidence of his qualifications to carry out the proposed program. Applications should also include a statement of funds needed from the Fellowship to a maximum of $3000. Address all communications to the Executive Secretary, American Society of Civil Engineers, 33 West 39th Street, New York 18, N. Y.

Freeman Fund Rules

1 The grant is offered in odd numbered years (September, 1961, for example, by the ASCE), and in even numbered years, a similar grant is offered by The American Society of Mechanical Engineers, all applications being judged on their merits regardless of Society affiliation.

2 Grants are made toward expenses for experiments, observations, and compilations to discover new and accurate data that will be useful in engineering.

3 The Fellowship also recognizes underwriting fully or in part some of the loss that may be sustained in the publication of meritorious books, papers, or translations pertaining to hydraulic science and art which might, except for some such assistance, remain mostly inaccessible.

4 The grant can be in the form of a prize for the most useful paper relating to the science or art of hydraulic construction.

5 Traveling scholarships are available. These are open to members younger than 45 years, in any grade of membership, in recognition of achievement, or promise. These are also for the purpose of aiding the candidate to visit engineering works in the United States, or in any other part of the world, where there is good prospect of obtaining information useful to engineers.

6 The grant may be for assisting in the translation, or publication in English, of papers or books in foreign languages pertaining to hydraulics.

ACTIONS ASME EXECUTIVE COMMITTEE

September 16, 1960

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on Friday, Sept. 16, 1960. There were present: W. L. Cisler, President; W. H. Larkin, H. N. Muller, and R. B. Smith of the Executive Committee; D. E. Marlowe, Vice-President; E. O. Bergman and L. N. Rowley, Directors; W. H. Byrne, President-Nominee; E. J. Kates, Treasurer; E. J. Schwanhausser, Finance Committee Chairman; A. C. Pasini, Past-Vice-President; O. B. Schier, II, Secretary; T. A. Marshall, Jr., Senior Assistant Secretary; W. E. Letroadec, W. E. Reaser, S. A. Tucker, and J. D. Wilding, Assistant Secretaries; J. J. Jaklitsch, Jr., Editor; H. I. Nagorsky, Controller; D. B. MacDougall, Associate Head, Field Service; and H. J. Heneman, representative of Cresap, McCormick and Paget.

Staff. *T. A. Marshall, Jr., resignation.* The Council voted to accept the resignation of T. A. Marshall, Jr., effective Oct. 15, 1960, with sincere regret but with congratulations. (See MECHANICAL ENGINEERING, October, 1960, p. 108.)

Council Policies. Council policies dealing with dues from members in foreign countries, appointments to inter-society or joint committees, how ASME selects its officers, and qualifications and duties of ASME Council members were approved as revised.

The Council voted to establish the "Guide to Society Legislative Activities" as Council Policy P-6.15 and to send copies of the policy to chairmen of every Section for inclusion in the Sections Operations Manual, ML-10, which had been mailed on July 29, 1960.

Research Executive Committee. *ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals.* In accordance with the Delegation of Authority to the Board on Technology and approval of the Research Executive Committee, the Senior Assistant Secretary, in the absence of the Secretary who was in Europe, executed the Research Agreement with Battelle Memorial Institute (ASME Project 7DP-14) "to solicit and process data for the use of the Subgroup on Metals Engineering of the Subcommittee on Ferrous Materials and High-Temperature Alloys of the ASME Boiler and Pressure Vessel Committee" for a period of six months at a cost of $3500.

Supplements to Research Agreements. In accordance with the Delegation of Authority and approval of the Research Executive Committee, the Secretary signed the following supplements to Research Agreements:

1 Supplement 1 to Research Agreement 95-1 with Massachusetts Institute of Technology extending the expiration date from June 30, 1960, to Jan. 31, 1961.

2 Supplement 1 to Research Agreement 7DP-10 with Battelle Memorial Institute extending the expiration date to Sept. 30, 1960 and increasing the cost from $7500 to $9000.

Joint Research Committee on Boiler Feedwater Studies. On recommendation of the Research Executive Committee and under its Delegation of Authority, the Board of Technology approved the research program on the corrosion problems on the water side of boiler tubes at an estimated cost of $150,000 over a period of two years; and authorized the solicitation of funds necessary to underwrite this project.

Research Committee Fund-Raising Campaigns. Under its Delegation of Authority, the Board of Technology, at its meeting on Sept. 12, 1960, authorized the following fund-raising campaigns by various Research Committees:

1 Research Committee on Lubrication—$45,000 for its project on friction and wear.

2 Joint ASTM-ASME Committee on the Effect of Temperature on the Properties of Metals, increased original $100,000 fund to $150,000 for planned research projects of the various panels over the next three to five years.

Edison Electric Institute Support of ASME Research on Ferrous and Heat-Resistant Alloys. Since the Boiler and Pressure Vessel Committee is not in a position to sponsor research projects, the Board of Technology reports that the Research Projects Committee of the Edison Electric Institute and ASME have agreed on a method of administering funds being made available by EEI to assist in financing evaluation studies on ferrous and heat-resistant alloys.

Custodian Funds for Research Committees. The Council authorized the establishment of a custodian fund for each of the following Research Committees: On Behavior of Pressure Vessel Materials and On Effect of Radiation on Materials.

Regular Nominating Committee. The Council approved the proposal that all Regular Members of the 1961 Nominating Committee attending the 1960 Winter Annual Meeting in New York City convene for the purpose of conducting business; but denied the payment of travel expenses and a per diem allowance to these members.

Sections. *Reassignment of Counties From the Shreveport Subsection to the Central Arkansas Subsection (Mid-Continent).* On Approval of the Shreveport Subsection and the Central Arkansas Subsection, both of the Mid-Continent Section, and on recommendation of Vice-President Grasse, Region VIII, the Council authorized the transfer of the following counties in Arkansas from the Shreveport Subsection to the Central Arkansas Subsection: Little River, Hempstead, Sevier, Nevada, Calhoun, Howard, and Ouachita.

Reassignment of Counties From the Central Arkansas Subsection to the Shreveport Subsection (Mid-Continent). On approval of the Central Arkansas Subsection and the Shreveport Subsection, both of the Mid-Continent Section, and on recommendation of Vice-President Grasse, Region VIII, the Council authorized the transfer of the following counties in Arkansas from the Central Arkansas Subsection to the Shreveport Subsection: Ashley and Chicot.

Section Status for Shreveport Subsection of the Mid-Continent Section. The Council authorized Section status for the Shreveport Subsection of the Mid-Continent

Section to be known as the ArkLaTex Section with headquarters city as Shreveport, La., and the territory to include the following counties and parishes: Texas Counties—Bowie, Titus, Morris, Cass, Panola, Marion, Gregg, Harrison, Rusk, Upshur, Shelby, San Augustine, Sabine, Camp, and Nacogdoches; Arkansas Counties—Miller, Union, Lafayette, Ashley, Columbia, and Chicot; Louisiana parishes—Caddo, Red River, Bienville, Lincoln, DeSoto, Sabine, Webster, Jackson, Bossier, Natchitoches, Claiborne, Winn, Union, Caldwell, Ouachita, Morehouse, Richland, West Carroll, Franklin, East Carroll, Madison, and Tensas.

Affiliation of the Miami Section with the South Florida Technical Societies Council. The Council approved the affiliation.

Student Sections. ***Changes of Name.*** The Society has been notified of the following changes in names of educational institutions: Southwestern Louisiana Institute to The University of Southwestern Louisiana and the Rice Institute to The William Marsh Rice University. The ASME Student Sections on these campuses have been renamed accordingly.

Winter Annual Meeting. ***Sunday Evening Topic.*** The Council requested the Board on Education to organize the program for the Sunday evening joint meeting of the Council with Boards and Committees on Nov. 27, 1960, within the framework of the suggested topic, "What Engineering Will Be in 25 Years From the Standpoint of Industry and the Engineering Profession."

Towne Lecture. Dr. Lyndall Urwick of London, England, has been invited to deliver the Towne Lecture on Wednesday, Nov. 30, 1960, at the Management Luncheon.

ASME Organization. The Council is to undertake a study of membership potential, growth and turnover, adequacy of services to members, and effectiveness of organization; it is to engage the firm of Cresap, McCormick and Paget to assist in such a study at a cost not to exceed $25,000; to request the Finance Committee to Allocate the necessary Funds; and to create an ad hoc committee of members of the Council which will be responsible for the conduct and the implementation of the study.

Calvin Rice Lecture. ***1961 Lecturer.*** Prof. O. A. Saunders of London, England, has been invited to deliver the Calvin Rice Lecture at the International Heat Transfer Conference, Aug. 28–Sept. 1, 1961, in Boulder, Colo.

Engineers' Council for Professional Development. ***Annual Report.*** The Council approved the formal report of the ASME Representatives to the ECPD for presentation to the Annual Meeting of ECPD to be held Oct. 3–4, 1960, in Montreal, Que., Canada.

Planning Committee Report. The Council approved the report of the ECPD Planning Committee dated July 25, 1960, and recommended to ECPD that the necessary changes in the ECPD Charter to implement their recommendations be prepared for submission to the governing boards of the participating bodies for their approval.

Engineers Joint Council. ***Amendments to the EJC Constitution.*** The Council approved the two amendments to the EJC Constitution relating to Membership of the Executive Committee and Membership Provisions.

United Engineering Center. ***Expenditures.*** The Council approved the expenditure of $46,920 for the purchase and installation of partitions, hardware, and drinking fountains; and for modifications to heating, ventilating, air-conditioning, and electrical systems on the floors to be occupied by the Society in the UEC.

Joint Awards. ***1960 Recipients of Awards in Which the Society Participates:***

Wallace Clark Award—B. W. Berenschot, the Netherlands

John Fritz Medal—Stephen D. Bechtel, San Francisco, Calif.

Gantt Gold Medal—Charles P. McCormick, Baltimore, Md.

Daniel Guggenheim Medal—Grover Loening, New York, N. Y.

Alfred Noble Prize—Ronald T. McLaughlin, Jr., Bangkok, Thailand

Elmer A. Sperry Award—Frederick D. Braddon, Garden City, N. Y.

Washington Award—Herbert P. Sedwick, Chicago, Ill.

Marston Award—Guy W. Morrison.

Deceased Members. ***Robert W. Angus.*** The death of Robert W. Angus, Vice-president of the Society from 1924 to 1926, on Thursday, June 30, 1960, was reported.

Joseph W. Eshelman. The death of Joseph W. Eshelman on Monday, July 11, 1960, was reported. Mr. Eshelman served the Society as Director, 1939–1942, and as Vice-President, 1942–1944.

Dr. Masawo Kamo. The death of Dr. Masawo Kamo, Hon. Mem. ASME since 1929, and recipient of its 50th Anniversary Medal, died on Monday, Aug. 29, 1960, in his home in Japan.

Certificates of Award. ***Board on Codes and Standards.*** Certificates of award have been prepared for the following members of ASA Sectional Committees for prolonged service: Earle C. Buckingham, Committee B4, 39 years; D. P. Adams, Committee Y15, 11 years; Frank C. Panuska, Committee Y14, 33 years; and Frederick G. Higbee, Committee Y14, 34 years.

Board on Honors. A certificate of award has been prepared for H. Drake Harkins, who served on the Board from 1956 to 1960, and as chairman in 1958 and 1960.

Medals Committee. Certificates of award have been prepared for the following retiring members of the Medals Committee: Robert C. Spencer, Jr., chairman; Henry M. Black; Oscar J. Horger; George T. Hayes; Jacob A. Keeth; George F. Nordenholt; Henry W. Page; and William P. Saunier.

Retiring Regional Chairmen. Certificates of award have been prepared for the following: Andrew H. Hines, Jr., Secretary, Region IV; Francis R. O'Brien, Sections Chairman, Region IV; Edwin E. Burroughs, Civic Affairs Chairman, Region IV; and J. W. MacPherson, MDC Chairman, Region VII.

Member Gifts Campaign Chairmen. Certificates of award have been prepared for the following: T. L. Whiteneck, San Diego Section, attained more than 100 per cent of its quota. Chairmen whose sections exceeded 50 per cent of members giving include A. C. Thiess, Piedmont-Carolina; G. H. Billman, Erie; and Paul Gravelle, Toledo.

Retiring Faculty Advisers. Certificates of award have been prepared for the following Faculty Advisers of ASME Student Sections; Harvey T. Munn, University of Arizona; James R. Van Dyke, University of Nevada; Cleve E. Lothgren, Oregon State College; Martin J. Siegel, University of Southern California; C. D. G. King, U. S. Naval Postgraduate School; and Eugene G. Pare, Washington State University.

Retiring Section Chairmen. Certificates of Award have been prepared for the following Section chairmen: 1958–1959, Arthur T. Jones, Jr., North Alabama-Mississippi; Fred Sanders, Southern Tier; and Harry W. Carlson, Waterbury. 1959–1960, Harold E. Peiffer, Akron; John J. Barrier, Atlanta; J. L. Brownlee, III, Birmingham; D. F. Watson, Columbia Basin; Richard J. Flanigan, Dayton; Carl R. Stahler, Iowa-Illinois; Frank P. Vinella, Minnesota; E. Landry Murphy, New Orleans; W. H. Owen, Piedmont-Carolina; and G. H. West, Jr., Northeast Florida Subsection.

Appointments. ***Boards, Committees, and Joint Activities.*** The Council approved the appointments to Boards, Committees, and Joint Activities.

Presidential. Tellers of Election: F. P. Bergonzi, William Kowalsky, and R. S. Touma.

Representative to UET Finance Committee; H. Edward Martin.

October 20, 1960

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on Friday, Oct. 20, 1960.

There were present: W. L. Cisler, President; T. J. Dolan, W. H. Larkin, H. N. Muller, and R. B. Smith of the Executive Committee; D. E. Marlowe Vice-President; L. N. Rowley and V. W. Smith, Directors; W. H. Byrne, President-Elect; E. J. Kates, Treasurer; H. J. Bauer, Assistant Treasurer; E. J. Schwanhausser, Finance Committee Chairman; C. E. Davies, Secretary-Emeritus; O. B. Schier, II, Secretary; W. E. Letroadec, W. E. Reaser, S. A. Tucker, and J. D. Wilding, Assistant Secretaries; J. J. Jaklitsch, Jr., Editor; H. I. Nagorsky, Controller; D. B. MacDougall, Associate Head, Field Service; Miss Kaufer and Mr. Schmelzer, representatives of Business Equipment Sales Company, Inc.

Board on Honors. *1960 Awards.* The Board on Honors voted by letter-ballot to grant the following 1960 awards:

Richards Memorial Award "For outstanding achievement in engineering within 20 to 25 years after graduation," to Ascher H. Shapiro, professor of mechanical engineering, M.I.T.

Pi Tau Sigma Gold Medal Award "For outstanding achievement in engineering within ten years after graduation," to George N. Hatsopoulos, associate professor in mechanical engineering, M.I.T.

Charles T. Main Award to John W. McDaniel, William Marsh Rice University, June, 1960, Kerrville, Texas, for his paper, "A Program of Continuing Broad Self-Education for the Engineering Graduate."

Undergraduate Student Award to Theodore C. Kuchler, Jr., Lehigh University, June, 1960, of Ruxton, Md., for his paper, "Reliability, A New Tool for Design."

Old Guard Prize to Joseph W. Lindsey, Student Member, University of Utah, June, 1960, of Hercules Powder Company, Bucchus, Utah, for his paper, "A Cold Flow Study of Nozzle Feeding in a Four-Nozzle Rocket Case."

1960 Annual Report. *Preliminary Copies of the Council.* Advance copies of the 1960 Annual Report of the Society which will be distributed at the Annual Business Meeting will appear either in multilith form or in black-and-white page-proof form. The final form which will be sent, in January, 1961, to the membership will be a two-color booklet.

Boiler and Pressure Vessel Committee. *1960–1962 Chairman.* The Council approved (*a*) the extension of the term of Henry E. Aldrich as chairman of the Boiler and Pressure Vessel Committee for one year, expiring June 11, 1962; and (*b*) that he represent the Committee on the Board on Codes and Standards during that period.

Professional Practice Committee. *Handbook of Consulting Practice for Mechanical Engineers.* The Council authorized the printing of the ASME Handbook on Consulting Practice for Mechanical Engineers.

Sections. *Cedar Rapids Subsection of the Iowa-Illinois Section.* The Council authorized formation of the Cedar Rapids Subsection of the Iowa-Illinois Section, with headquarters at Cedar Rapids, Iowa, to comprise the Iowa Counties of Linn and Johnson.

Affiliation of Sections With Local Engineering Groups. In accordance with the request of the Council, the Organization Committee examined the Constitution and By-Laws with a view to tightening the controls for approving affiliations of Sections with local engineering groups. The Organization Committee was of the opinion (*a*) that Article R11, Rule 7 was completely adequate and (*b*) that the handling of affiliation requests must be improved through more adequate investigation by the respective Vice-President, the Staff, and legal council, if necessary; and directed that Council Policy P-6.15, "Guide to Society Legislative Activities," be brought to the attention of all Sections contemplating affiliation with any local engineering group.

Student Sections. *University of Puerto Rico Student Section.* When the proposed ECPD inspection of the mechanical engineering curriculum at the University of Puerto Rico was postponed, the Executive Committee of the Council granted an extension to the ASME Student Section which was established in 1923. Inspection of the mechanical engineering curriculum at the University of Puerto Rico by an ECPD team resulted in its accreditation at the ECPD Annual Meeting, Oct. 3–4, 1960, in Montreal, Que., Canada.

Group Disability Insurance Committee. *Life-Insurance Coverage.* The Council voted to extend the terms of reference of the Group Disability Insurance Committee to include the study of the possibility of including Group Life Insurance for ASME members.

Member Gifts Campaign. *Report.* W. H. Larkin, at the request of the President, has taken over the direction of the Member Gifts Campaign and feels certain that considerable improvement can be made within the next six weeks.

United Engineering Center. *Authorization for Expenditures.* The Executive Committee expressed satisfaction with the plans and cost figures as presented and authorized the expenditure of $12,000 for the refinishing and rehabilitation of equipment and art objects to be used and $94,000 for new furnishings; these expenditures to be made from the $150,000 transferred from the General Fund Unallocated Surplus by action of the Council and the balance of the funds authorized in 1957 and amended in 1958.

ASME Organization Study. The Council voted a sum, not to exceed $24,000, be taken from the Society's Development Fund Reserve to finance a study of membership potential, growth and turnover, adequacy of services to members and effectiveness of the ASME organization.

Engineers' Council for Professional Development. W. H. Larkin, ASME Representative to ECPD, presented a report on the 28th annual meeting of ECPD which was held Oct. 3–4, 1960, in Montreal, Que., Canada.

Power Show. *Additional Payment.* An additional contribution to the Society from the Power and Mechanical Engineering Exposition held in 1958 was received from the International Exposition Company in the amount of $70.16. This amount bringing the total to $14,902.94 has been added to the general research funds of the Society.

EUSEC. *Recommendations.* At the Seventh Conference of Engineering Societies of Western Europe and the United States, held on Aug. 29–Sept. 3, 1960, in Brussels, Belgium, recommendations were submitted to the participating societies for action.

Members Working Abroad to Be Encouraged to Participate in Local Society Activities. They approved the recommendation to EUSEC Conference with regard to encouraging members of the Society who are working abroad to participate in the professional activities of the local society in the country in which they are working.

EUSEC Report of Engineering Education and Training. The Council approved the recommendation of the EUSEC Conference to publicize the EUSEC Report on Engineering and Training through MECHANICAL ENGINEERING and ECPD and to insure its appropriate distribution in this country through ECPD.

Publication of National Report on Engineering Education and Training. The Council approved the publication by ECPD of the National Report on Engineering Education and Training.

Assessment of Engineering Qualifications Obtained in Countries of Member Societies. The Council approved the recommendation of the EUSEC Conference that when an assessment of engineering qualifications received in another country is needed, the Society should deal with representatives of the society in that

country and keep the EUSEC Committee on Engineering Education and Training informed.

Support of Research and Development in the Engineering Sciences. The Council approved the recommendations of the EUSEC Conference with respect to the support of research and development in the engineering sciences.

Deceased Members. *Kilshaw M. Irwin.* The sudden death of Kilshaw M. Irwin, Fellow ASME and Vice-President of the Society, 1939–1942, on Monday, Oct. 3, 1960, was reported.

Certificates of Award. *Retiring Section Chairmen:* Certificates of award have been prepared for the following: William J. Law, Baltimore; R. T. Paluska, Central Illinois; M. L. Jones, Delaware; Theodore Chanoux, Fairfield County; C. Chester Bigelow, Hartford County; Edward A. Lyle, Mid-Continent; William C. Krutsch, Jr., North Jersey; Robert S. Sherwood, Olean; H. A. Thurstin, Rocky Mountain; H. J. Loberg, Southern Tier; Joseph W. Lux,, Waterbury; and Charles Colangelo, Long Island Subsection.

Appoints. *Presidential.* Honorary Vice-Presidents to attend Kilshaw M. Irwin's funeral, Oct. 6, 1960, in Radnor, Pa., included W. L. Batt, D. W. R. Morgan, C. C. Franck, Jr., N. E. Funk, and T. S. Fetter, Jr. President Cisler also attended.

ASME Council Actions on 1960 National Agenda Reported

How the National Agenda is compiled for Regional Administrated Committees and Items which are ultimately acted upon by Regional Delegates Conference

At a meeting of the Executive Committee of the Council of The American Society of Mechanical Engineers, held at Society Headquarters, New York City, on Oct. 20, 1960, approval was voted of statements and actions on the recommendations of the 1960 Regional Delegates Conference submitted to the Council at the 1960 Summer Annual Meeting, Dallas, Texas, June 4, 1960.

These recommendations, the actions of the Regional Delegates Conference on them, and the actions or statements of the Council are reported in what follows. A detailed description of the procedure by which agenda items are prepared and acted upon by the Sections, the Regional Administrative Committees, the Regional Delegates Conference, and, finally, the Council follows the report on the 1960 recommendations.

Final Report on 1960 RDC Recommendations

Agenda Topic No. 6: One Envelope Be Used for Ballot. It is proposed that one opaque or tinted envelope be used to replace the double untinted envelopes currently being used in connection with the membership balloting for Council members of the Society and for Constitutional amendments.

Delegates Action: Approved 15 to 0.

Council Action: The Council on June 5, 1960, adopted the amendments to Article R7, Rules 4, 7, and 8:

Rule 4 In the election of officers and directors, the voter shall prepare his ballot by crossing out the name of any candidate or candidates rejected by him and may write in the name of any eligible member of the Society, and shall enclose the ballot in the return envelope marked "Ballot for Officers and Directors," seal it, and then place his personal signature thereon for identification.

Rule 7 The Tellers shall supervise the opening of the envelopes and canvass the results.

Rule 8 A ballot without the autographic endorsement of the voter on the ballot envelope is defective and shall be rejected by the Tellers of Election.

And to Article R16, Rules 1, 4, and 5:

Rule 1 In voting on an amendment to the Constitution the voter shall prepare his ballot by crossing out that part of the amendment which he wishes to vote against, or by marking the ballot as indicated. He shall then enclose the ballot in the return envelope marked "Ballot on Amendment," seal it, and then write his name thereon for identification.

Rule 4 The Tellers shall supervise the opening of the envelopes and canvass the results.

Rule 5 A ballot without the autographic endorsement of the voter on the ballot envelope is defective and shall be rejected by the Tellers.

Agenda Topic No. 7A: Regular Nominating Committee Members Be of the Member or Fellow Grade: It is proposed that all members of the Regular Nominating Committee shall be of the Member or Fellow Grade.

Delegates Action: Approved 9 to 6.

Council Action: On recommendation of the Regular Nominating Committee, the Council on Oct. 20, 1960, voted to refer to the Constitution and By-Laws Committee the matter of providing amended language to Article B7 stipulating that members of the Regular Nominating Committee shall be of the Member or Fellow Grade.

Agenda Topic No. 43: Change Regional and Administrative Year: It is proposed that the Society's Regional and Administrative years be changed to parallel more nearly the existing Section year—July 1 through June 30.

Delegates Action: Approved 15 to 0.

Council Action: The Council, on June 5, 1960, approved amendments to the Constitution and By-Laws providing for the change of the Administrative year to July 1 through June 30 and voted to include an explanation on the ballot for new officers so that the exception to Article C7, Section 4 of the Constitution and By-Laws would be concurred in by the members of the Society thereby permitting the extension of the term of office by six months of all Council members elected on the September, 1960, ballot:

"For many years, the Regional and Administrative years of the Society have been December 1 to November 30. There have been several disadvantages to this, the main one being that the terms of office for members of the Council, Boards, and Committees have been out of phase with Section and Student

Nominations for ASME Honors

Members and agencies of The American Society of Mechanical Engineers including Boards, Committees, Sections, and Professional Divisions—except members of the Council and the Board on Honors, are invited to submit nominations for Society honors and awards as described in the ASME Honors Manual MS-71. Nominations for 1961 must be in the hands of the Board on Honors prior to March 1, 1961.

As important changes have been made in the nominating procedures and the Manual, it is *essential* that those wishing to make a nomination secure a copy of the Honors Manual dated October, 1960, by writing to the Board on Honors, ASME, 29 West 39th Street, New York 18, N. Y. Please note carefully information given on pages 3, 6, 11, Chapters III and IV, and particularly Appendix I.

Section activities which extend from July 1 through June 30.

"As a result of a unanimous recommendation made by the 1960 Regional Delegates, the Council on June 6, 1960, approved a change in the Regional and Administrative years to parallel more nearly the Section and Student Section years and amended the By-Laws accordingly. To implement this change, each member continuing to serve on the Council, Boards and Committees after November 28, 1960, will have his term of office extended one half year. For the sake of simplication, the additional one half year shall be served between November 28, 1960, and June 12, 1961.

Thereafter, all terms shall expire immediately following the Business Meeting at a Summer Annual Meeting.

"Similarly, the terms for the new members of the Council, listed on the 1960 Ballot, will be extended one-half year which constitutes an exception this year only to Article C7, Sec. 4 of the Constitution.. Since this is a temporary adjustment, the Constitution and by-Laws Committee prefers not to amend Article C7, Sec. 4 and asks your concurrence with this procedure."

Items Rejected

To complete the record, the following item that appeared on the agenda for the Regional Delegates Conferences was rejected: No. 1 1.1-60 First and Second Compilation to be Mailed Directly to Section Executive Committee.

ASME Procedure in Preparing and Discussing Agenda Items

THE American Society of Mechanical Engineers has developed a procedure whereby action is taken by all Sections on suggestions made by any Section to improve policies, procedures, and operations of the Society. This procedure starts with the compilation by the National Agenda Committee of preliminary statements of the items suggested. If one third of the Sections approve any one item, it is included in a National Agenda for discussion at Regional Administrative Committee meetings held in the spring.

Further discussion at a national level takes place at the Regional Delegates Conference held during the Summer Annual Meeting. The results of this Conference are then submitted to the Council.

The principal business of the Regional Delegates Conference held during the Summer Annual Meeting is to consolidate the actions of the eight RAC meetings on the National Agenda and to report the consolidated view to the Council. Related matters frequently arise on which a consolidated view is developed, or on occasion the Council may request the opinion of the RDC on a Society policy or procedure. The Council is usually in session at the same time as the RDC and provision is made for the Delegates to attend the Council Meeting.

A report of the actions of the Conference is made to Council during the Summer Annual Meeting. The Council after studying the recommendations of the RDC refers to the various administrative agencies of the Society the different items with which those agencies are concerned.

After considering comments received from the administrative agencies, the Council acts on the recommendations of the RDC. These actions were reported to the Delegates and Section Executive Committees on Oct. 20, 1960. They also are reported in MECHANICAL ENGINEERING as soon thereafter as possible. Thus the cycle from origination of items by the Sections to a reporting of actions by Council is completed within one year.

Compilation of the National Agenda

About September 1 of each year, the chairman of the Agenda Committee sends forms to the Sections and requests the submission of items by the end of October.

Upon receipt of the items, the Agenda Committee reviews them, corresponds with the suggesting Section, and refers the items that can be dealt with promptly as administrative matters to the proper administrative agency.

On December 19, a compilation of all items accepted by the Agenda Committee will be sent to the Sections for an expression of opinion as to inclusion in the final agenda. By Feb. 1, 1961, the Agenda chairman must have all the opinions. One third of the Sections must approve an item before it can become a part of the National Agenda, which is sent out to all the Sections at least four weeks in advance of the first RAC meeting.

Action in the Sections

The National Agenda requires action in the Section Executive Committee on at least three points:

A In the original suggestion of items. In this process it is desirable to canvass member opinion by some method, by mail, or at a Section meeting.

B The expression of opinion about including an item in the National Agenda.

C A determination of the position the Section is to take on the items in the National Agenda.

It is generally desirable for the Section to select its representatives to the RAC meeting at an early date so that they may be in touch with the entire process of developing the National Agenda.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

THESE items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 60 per cent of the first month's salary if a nonmember, or 50 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

NEW YORK
8 West 40 St.

CHICAGO
29 East Madison St.

SAN FRANCISCO
57 Post St.

Men Available[1]

Chicago Office

Chief Engineer or Factory Manager, 44; PE, 20 years in the fields of factory management and design engineering, civil, mechanical, and industrial as a consulting engineer. $15,000. Prefers U. S. ME-2030

Power Engineer, BSME, 37; Registered, 14 years in field of industrial-power plant and management, experienced in following area:

[1] All men listed hold some form of ASME membership.

Equipment application, equipment performance evaluation, heat-balance studies, plant layout and design, plant maintenance. $12,000. Prefers any metropolitan area. ME-2031.

Chief Engineer Research or Development, BSME, 35; 11 years metalworking experience, plant engineering, process engineering, equipment sales. Experienced in "cold forming" processing, manufacturing, and equipment. Well known in metal-forming industry. $12,000. Prefers Midwest or West. ME-2032.

Plant Manager—Metalworking, Industrial Management, 47; 15 years' managerial experience plus seven years in engineering and sales, qualifications to operate a plant smoothly through proper controls at a profit with attention to customer service. Familiar with latest techniques in production, controls, budgets. Strong ability to lead or influence people. $15,000. Prefers South or Midwest. ME-2033.

Industrial Engineer, BSME and Bus. Admin. 29; 2½ years with management-consulting firm performing analysis of a wide variety of business resulting in cost reductions and profit improvements and 4½ years systems-procedures analyst for manufacturer of jet engines. Salary open. Prefers Chicago or North Shore Suburbs. ME-2034.

Director of Research and Development, MS, PHD in ME, 41; 18 years' diversified experience from project engineering through directing research effort from idea conception through marketing developed product. $20,000. Prefers South or Southwest. ME-2035.

Management or Staff, BSME, PE, Mich., 43; 25 years' diversified experience in design, administration, management controls, schedules, earning and planning curves; expert on Line of Balance (technical paper). Grad. Draftsman Apprentice. $10,000. Prefers Midwest. ME-2036.

Administrative Engineer-Staff Level, domestic and/or international Company, BSME, 54; 30 years' experience. Have successfully completed one year of independent technical consulting and international license negotiations. Formerly senior vice-president of small but well-known Cleveland research and development organization. Have many successful patents and promotions. $25,000. Location open. ME-2037.

New York Office

Executive—Sales Manager—Sales Engineer, BS ChE, 25 years with machinery, equipment, and systems for the power, process, and defense industries. Experience includes assistant to president, manager contract research and development, manager new products, assistant to vice-president—sales, sales engineer. $15,000–$20,000. Location optional. Me-884.

Engineer, pipeline or plant, BSME '55. All phases of pipeline engineering as assistant plant engineer for small crude oil pipeline company for two years; two years' experimental stress analysis and applied mechanics with major builder of engines and compressors. $9000. East or Midwest. Me-885.

Plant Engineer, BSME, 23 years' experience plant-engineering field, solid supervisory background in design, construction, and maintenance of machinery, buildings, and equipment; also utilities, fire protection, safety, plant security, sanitation, and outside contractors. PE, N. J. $10,000 minimum. Metropolitan N. J. Me-886.

President, Executive Vice-President, or General Manager, ME and EE degrees. Broad management background, training modern management techniques, heavy machinery and steel-mill operating experience, sales and marketing, manufacturing, and engineering. $25,000. Location open. Me-887.

Industrial Engineer, BIE, NYU. Five years' experience primarily in time study and wage incentives including MTM, standard costs, budgets, work sampling, office systems, plant layout, methods, and cost reduction. $8000. New York Metropolitan. Me-888.

Manufacturing Engineer of Plate Manager, BME. Five years as chief IE; five years plant manager in manufacturing; experienced methods, jig and fixture design, automation, systems and procedures, time and motion study, plant layout and maintenance, labor relations. $12,000. Prefers Philadelphia-Camden-Trenton area. Me-889.

Area Engineer, BSME. Nine years' experience new construction and maintenance of modern refining and power-plant facilities in capacity of area and project engineer. Prefers East or South. Me-890.

Production-Planning-Design Engineer, BME. Two years construction and startup of hydrometallurgical nickel cobalt plant as field engineer and shift engineer. $6300. New York City. Me-891.

Recent Graduate, BME and AB (Econ.), Union College. Some summer experience. Desires position in aviation, rocketry, or related components. North N. J. or New York City. Me-892.

San Francisco Office

Junior Mechanical Engineer, 22; interest in maintenance or production in metalworking product manufacturing involving machinery, mechanisms, production scheduling, or plant services. About $6000. Prefers San Francisco Bay Area. Home: San Francisco. Se-104.

Designer, Production Engineer, ME plus Management, 29. Six years' experience—two years installation and service of missile handling, propellant transfer, plant equipment; two years production design, test, and evaluation of missile structural and prototype, dealing with shop, vendors on manufacturing, tool, materials; two years missile check-out and adjustment of pneumatic and propulsion systems. Strong desire for nonweapon design, installation of plant, or process equipment. Prefers San Francisco Bay area. Home: San Francisco. $7500 up. Se-115.

Designer, 24. Six years' experience designing, drafting, making tools, dies, jigs, fixtures, automated systems, machinery, mechanical systems for product manufacturer, tool job shop, engineering department on metalworking, metal forming, assembly, special, production and process machinery, and tooling. Prefers San Francisco Bay area. Home: Marin County. About $8000. Se-117.

Plant Engineer, ME, 31. Six years' experience chemical-process plant equipment layout, design, estimating, installation, maintenence, revision, and expansion. $8400. Prefers: San Francisco Bay area. Home: Ill. Se-122.

Methods Engineer, IndMgt, 27. Advanced training in methods, time measurement, and statistical work sampling. A year and half of direct application of the above basic job study through presentation to plant management. Large national can manufacturer. $8000. Prefers: West Coast. Home: N. J. Se-148.

Plant Engineer, ME, 44. Seven years in responsible charge of operation of power-plant equipment (boilers, turbines, etc.). Ten years in responsible charge of design of machinery (excavators, hydraulic presses, etc.). $12,000. Prefers: San Francisco Bay area. Home: Calif. Se-155.

Design, Draftsman, ME, 34. Five years' design and drafting experience in mechanical drafting in air conditioning, ventilation, plumbing and piping layout, and fire-protection system. $5000. Prefers: West Coast. Home: Guam. Se-157.

Chief or Plant Engineer, 48. Registered PE, Texas, Colo.; 25 years' experience mechanical design, construction, and maintenance, with 18 years supervisory capacity in large scale chemical-processing plants. Ability and capacity for getting things done. $10,000. Prefers: West, Southwest, Midwest. Home: Southwest. Se-158.

Product Manager, ME, 37. Possess supervisory ability to direct engineering activities on a management level, which includes working with sales in defining product specifications to meet customers' requirement, directing product through research and development functions, assisting production engineer in moving product into production, and following product into field to see that it satisfies requirements. $13,000–18,000. Prefers: Calif. Home: Calif. Se-170.

Sales Engineer, ME, 29. Heavy experience in reinforced plastics—design, development, production as chief engineer. Versatile and easily adaptable to sales or other products because of frequent customer contacts and broad outlook. $8400–9600. Prefers: San Francisco Bay area. Home: Calif. Se-214.

Design, Development Engineer, ME, 35 Registered ME; seven years' experience in charge of design, development, test, releasing for manufacture of nonnuclear portions of specific weapons, for government agency. $11,500. Prefers: Foreign. Home: Calif. Se-249.

Staff Engineer, ME, 43. At present staff engineer and general superintendent for group of cottonseed-oil mills and cotton gins including coffee processing, soapmaking. Responsible for operations, processing, cost control, engineering, construction, and general supervision, for U. S. company in Peru. Plants located throughout country. Speak Spanish. Relocate in U. S. or South or Central America. Salary open. Home: Peru. Se-299.

Design, Development, ME, 32. Four years' experience, planning, investigations, design, development, supervising installation of heavy machinery and material-handling equipment for a steel service and fabricator. Prefers: Japan, or opportunity for Japan. $8000. Home: Chicago. Se-1357.

Sales Engineer, ME, 28. Engineer officer three years of Navy ship, responsible for maintenance and operation of all mechanical and electrical machinery. Two years sales and application training with heavy industrial and electrical equipment manufacturer. $7200. Prefers: West Coast. Home: San Francisco Bay area. Se-1533.

Junior Plant Engineer, ME, 23. Sound mechanical-engineering background in machine design, creative and imaginative, experienced and successful with people. Certificate of engineer-in-training, Calif. Salary open. Prefers: West Coast. Home: Calif. Se-1741.

Plant Engineer, Designer, ME, 39. Three years process, plant design, oil dehydration, and water clarification for a petroleum producer and refinery. Four years design and build refineries, also plant engineer. Three years mechanical construction water-treatment plant for uranium processing. Six years operating and maintaining diesel, gas plants. Prefers West, Southwest, or Midwest. $10,000 up. Home: Ariz. Se-1699.

Staff Plant Engineer, MSME, plus MBA, 38. Responsible for engineering management, design, draft, production in foods, processes instrumentation. $12,000. Prefers: Los Angeles or Foreign. Home: Southern Calif. Se-1871.

Positions Available

Chicago Office

Assistant to Vice-President, Grad. Mech. 35–45; minimum ten years' experience in high-pressure and high-temperature piping and power-plant work. Will assist vice-president in estimating, construction, labor relations, budgets, procurement, customer relations, and general administrative functions. Must have exceptional personality for handling labor and field engineers for a contract. About $15,000. Chicago. Employer will pay the fee. C-8367.

Engineers, (a) Organic Chemist, BS or MS, research & development on organic and analytical chemistry. (b) Mechanical R&D on space technique, some structure-analysis experience necessary. (c) Mechanical R&D on vacuums, R&D of thermodynamics and refrigerations for space-heating division. (d) Electrical R&D circuits, electrostatic dust removal, etc. $11,000–12,000. 30 miles N.W. of Chicago. Employer will pay the fee. C-8338.

Staff Industrial Engineer-Foundries, Grad. IE or ME, five plus years' experience in grey iron or malleable iron foundry setting standards, methods, time studies, etc. Will be assigned to client's plant in Argentina, S. A. for at least two years than back to Chicago on staff. Will consider married man without children of school age. $10,000–15,000 plus a per diem allowance for first three months of employment. Round trip transportation for man and family. For a consultant, employer will pay the fee. C-8329.

Development Engineer, ME or Chemical 0–5 years' experience for work on nuclear equipment design heat-transfer calculations, supervising and inspection of equipment construction, and responsibilities extending from design conception to operation. Background in process or power industry helpful. Can use noncitizen if here on permanent visa. $8000. Chicago Loop. Employer will pay the fee. C-8320.

Plant Engineer, Grad. EE, ME, Chem. or CE, to 40; six plus years' experience in general engineering work in a manufacturing plant on installation, operation, and maintenance of equipment and buildings including pumps, compressors, conveyers, dryers, crushers, piping, refrigeration equipment, grinding mills, and presses. Must have had two years' experience in supervision or staff work. Duties: Will prepare sketches and layout drawings for installation of new or replacement of existing equipment, buildings, and facilities. Size and select pumps, piping, compressors and condensers, develop

automatic control systems, prepare engineering reports, analysis, and equipment specifications. Develop and prescribe economical methods and materials for maintenance of equipment and buildings for a manufacturer of food products. Salary open, Chicago, Ill. Employer will negotiate the fee. C-8302.

Sales Engineers Trainees (2), college grads. 26–29; application and sales of industrial-burner systems. Company manufactures industrial gas and oil-burning equipment and accessories for use on heat-processing units such as furnaces, ovens, kilns, boilers, etc. Must have completed military service; company is extremely selective as regards to character, sales personality, mechanical aptitude; above average intelligence with record of good grades in mathematics, physics, or chemistry. Training period dependent upon previous experience. 25 per cent travel after assigned to territory. Salary open. Headquarter Ind. Employer will pay the fee. C-8288.

Senior Test Engineers, BS or MSME; to 40; experienced in engineering testing and background in preparation of test reports, plus strong familiarity with standard engineering and instrumentation practices and their application to test. Duties: Perform complex engineering test reports on afore-mentioned. This includes reviewing assigned work order on any complex test required including proposed method of instrumentation and test procedures with supervisor and project engineer and determine availability of instruments. Constructs and/or supervises construction of any special test equipment required. Sets up and/or supervises set up of test equipment devices to be tested and instrumentation using technician as assigned. Conducts test operations and collects data as required. Review test data and make recommendations for alteration, improvement in design, additional testing, or report presentation. Write all test reports based on data obtained by himself or technicians assigned for a specific test. To $7800. Chicago. Employer will pay the fee. C-8269A.

Senior Design Engineer, ME degree, five years' successful design experience as a product designer to handle the mechanical design from the nucleus of an idea to the finished and tested product. Must be familiar with current shop practices and processes and have a working knowledge of the proper application of materials, finishes, and tolerances. Product design of instruments and controls for process and heavy industry. $8000–10,000. Chicago. Employer will pay the fee. C-8262A.

Plant-Project Engineer, ME, EE, or CE; 30; under direction of chief plant engineer to work on general plant engineering including design and installation of equipment for boxboard manufacturer. To $7800. Chicago. Employer might negotiate the fee. C-8225.

New York Office

Industrial Engineer, graduate IE or ME, one year's shop experience in methods, standards, layout, etc., for company manufacturing molded and laminated plastics. $7500, plus or minus. Company pays placement fee. North Del. W9789.

Plant Engineer, at least eight years' experience in food or allied fields covering materials handling, processing, maintenance, equipment evaluation, reports, etc. $9000–$10,000. Md. Company pays placement fee. W9788.

Plant Engineer, ME graduate, at least five years' plant-engineering and maintenance experience in chemical-process fields including building construction and equipment installation. $8000–$10,000. N. J. W9787.

Engineers. (*a*) Senior product-design engineer, minimum of eight years' product-design background, for directing the design of major components, principally servomechanisms. To work from design directives, specifications, precision electrohydraulic products for volume production. $10,000–$12,000, plus management-profit sharing. (*b*) Production engineer, BSME or BSEE, five to ten years in one or more of the following areas: Product engineering and design, production engineering, servomechanisms, hydraulic components, and/or controls. To develop procedures for production testing, assembly and rework, maintain liaison with production, sales, and customer relative to product specifications and standards. $8000–$10,000, plus profit sharing. (*c*) Prototype engineer, BSME or BSEE, minimum of two years background in hydraulic, pneumatics, or electronics necessary. Experience in design, instrumentation, controls, and liaison highly desirable. To assume responsibility for revising customer specifications to determine internal components. $7500–$10,000, plus profit sharing. Company pays placement fees. Buffalo, N. Y. W9784.

Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

General Foreman, Maintenance Department ME or EE, minimum of five years' experience in the foundry industry. Job involves supervisory responsibility for all maintenance department personnel and several shift foremen in steel foundry. Pa. W9783.

Chief Industrial Engineer, graduate ME, IE, or BA, from five to ten years' experience, to take charge of production and manufacturing in the graphic arts industry. Experience in the paper or printing industry desirable. To $12,000. New York City. W9779.

Professor of Mechanical Engineering, to develop research and education programs in the design area. Salary open. Midwest. W9776.

Senior Production Engineer, ME or EE, seven to ten years in company manufacturing small electromechanical devices. $9000–$10,000. N.J. W9772.

Sales Engineer, ME or AE, or heavy engineering background, with design, project, or systems experience. Knowledge of defense industries dealing in heavy machinery, mechanisms, missile ground-support equipment, etc., is essential. Should have contacts with Armed Services or weapon system prime contractors. $10,000–$12,000. Company pays placement fee. Headquarters, N. J.; Territory, Southeastern U. S. W9771.

Mill Engineer, BSME, BSEE, ten years' overall experience, three to five years in the paper industry. To participate in selection of equipment, order major items and necessary auxiliaries; organize preventive maintenance procedures in the paper mill, etc. $9000–$10,000. N. J. W9763.

Mechanical Engineer, preferably graduate ME, to inspect, write up specifications, purchase, and approve all types of mechanical equipment. Must have PE license. $8000. New York City. W9762.

New Products-Development Engineer, graduate CE or ME to design and develop products in connection with scaffolding; i.e., metal plate, hardware, pipe, etc. $8000, plus. New York City. W9759.

Consultant, experienced in the design and operation of large modern dairies. Salary, open. Conn. W9756.

Development Representative, for sales department of an integrated tubular steel mill. Mechanical graduate, five years' experience in structural design or engineering consulting. Will be in charge of structural-design applications using hollow sections, availability, use, treatment, and specifications of materials. About $10,000 Pa. W9736.

Application Engineer, BSME, experience in development, design, and production engineering equipment manufacturer of components such as bearing, specialty fasteners, or adhesives for new concept in adhesives in the application of locking threaded fasteners, mounting bearings. Salary open. Conn. W9734.

Assistant Manufacturing Engineer, graduate ME, some experience in sheet-metal products including design layout production, cost controls, profit analysis for small plant. $8000–$9000. New York Metropolitan area. W9729.

Manager of Product Engineering, (Chief Engineer), preferably graduate ME, with product design and development experience at managerial level. Experience in the design of electromechanical components for the radio-television industry desirable; some experience in the automotive, electrical appliance, or office equipment industries also helpful. Will plan and direct product-engineering and quality-control activities including product design, advanced development, new manufacturing processes, application engineering, quality standards and controls, etc. $18,000–$25,000. Ill. W9727.

Application Engineer, graduate mechanical preferred, to work in gas and liquid flowmeter division of company. Experience in the marketing and servicing of specially engineered products required, but not necessarily in this field. Some familiarity with industrial-process instrumentation, particularly in the oil, gas, or chemical-process industries helpful. $8000–$10,000, plus profit sharing, plus company benefits. Northeastern. U. S. W9715.

Sales Engineers. (*a*) Industrial sales engineer, graduate mechanical, electrical, industrial, or chemical, four years' related experience, to be responsible for the promotion and sale of regulators, recorders, transmitters, valves, and controllers of pressure, temperature, and humidity to OEM accounts, processing industries, wholesalers, and consulting engineers on a noninstalled basis. $7200–$9600, plus company-maintained fringe benefits and profit-sharing program. Northern N. J. (*b*) Contract sales engineer, trainee, graduate mechanical, electrical, or industrial, with some training in refrigeration, heating, and air conditioning. Will be given a planned program of training in sales office. This includes related job experience utilizing technical training. $6300–7200, plus company-maintained fringe benefits including profit-sharing program. Company pays placement fees. Upstate N. Y. W9712.

Mechanical Engineers. (*a*) Chief mechanical engineer, graduate, minimum to ten years' refrigeration experience, to supervise product design of AC products, supervise laboratory and all laboratory functions, co-ordinate all design and development of AC and allied products. $12,000–$15,000. (*b*) Senior mechanical engineer, graduate, minimum of five years' experience, to supervise all laboratory functions in connection with development of room air conditioners. Must be familiar with theory and test work on hermetic refrigeration systems, heat-transfer surfaces, etc. $8000–$10,000. (*c*) Senior mechanical Engineer, graduate, minimum of five years' refrigeration experience, to design and develop window-type room air conditioners in sizes from $^1/_2$ to 2$^1/_2$ hp. Must have knowledge of heat-transfer surfaces, air handling, and fan motors. $10,000–$12,000. N. J. Metropolitan area. W9706.

Civil or Mechanical Engineer, familiar with industrial construction having ability to write specifications for structural and architectural work from design drawings. Also would write piping, heating, equipment, and instrument specifications from operating and design data furnished by staff engineers. Salary open. Western Pa. W9798.

San Francisco Office

Sales Engineer, engineering background and knowledge of equipment sales (preferred in packaging field). Will contact clients concerning cannery warehouse and food industry overwrapping and code marking and imprinting equipment (canneries, bakeries, supermarkets, sausage kitchens, bottling plants, etc.). Work in developed territories quoting on needs for such equipment and prepare specifications, supervise installations and startup. Five per cent sales-and 5 per cent installation basic commission set up. $150,000 gross potential. One for Southern Calif. and Ariz.; one needed for San Francisco Bay area. For manufacturer's representative. Sj-5697-R.

Designers, ME, any age. To assist in development of mechanical systems and able to do required board work along with some development requiring original thinking for program of development of series of proprietary devices, mainly in field of unique and hi-performance servomechanical transducers; including closed-loop accelerometer acceleration switches; single and double-integrating accelerometers, pressure and pressure-ratio devices. $8000–$9000. San Francisco Peninsula. Sj-5694-R.

Operating Engineer, ME, under 40. Experience in one of the following: Maintenance, operating experience, or construction; in field of high-pressure steam plants. To supervise results engineers, chemist, and related personnel in 200-megawatts steam plant. For a utility. Start $685 per month, opportunity for advancement. Wyo. Sj-5690-R.

Instrument Engineer, EE, ChE, or ME, five years' experience in refinery and chemical-plant instrumentation. Experience in nuclear reactor instrumentation advantageous. To engineer systems and write specifications for basic instru-

ments, control systems, safety interlocks and relief systems for refineries, chemical plants, and nuclear reactors. $7500–9000. U. S. citizen. Southern Calif. Sj-5680-R.

Sales Engineer, ME, young, recent graduate to three-years' working experience, mechanical aptitude; able to read blueprints, assemble, measure, and layout available space, compute requirements involving presentation, promotion, and sale of hand-held small pneumatic tools, dealing with established clients and new industrial clients. For district office of national organization. Must be willing to accept assignments anywhere after one or two months factory training in Pa. Start with straight salary and work into salary plus commission. Car furnished. Sj-5670.

Sales Engineer, EE, ME, or ChE, 29–35. Minimum five years' sales or process-plant experience; provide technical assistance to clients and promote sale of instrumentation (electrical, pneumatic, mechanical); to provide for control, actuators, direct reading, or recording instrumentation for temperature, pressure, rate of flow, etc., in process plants (chemical, petroleum, petrochemical, foods, etc.). For manufacturer's district office. $7200 up, plus company car and fringe benefits. For Northwest area; Los Angeles headquarters. Sj-5663-R.

Designers, ME, minimum of five years' experience in design of refinery, petrochemical or chemical plants, or related. Able to relate all phases of this type of work from beginning to completion. Salary commensurate, relocation allowance and employer will pay placement fee. For engineering builder. San Francisco. Sj-5655-R.

Mechanical Designer, ME, Licensed, 38–50. Well-qualified by recent supervisory and design experience (possibly operated his own office or chief assistant in consulting office) in the field of mechanical design including process-type mechanical equipment and with particular emphasis on heat, ventilation, and air conditioning. Consulting engineering firm has a staff to support him and he may participate on full-time or part-time basis. Provisions made to compensate for work brought in and some arrangements may be made for doing other work. Compensation is on minimum monthly free basis and hourly basis for work in engineering department and percentage of gross on work brought in. For consultant. San Francisco East Bay. Sj-5655.

Instrumentation Designer, EE, ME, or equivalent. At least five years' experience application and systems design of instrumentation for chemical, petroleum, or petrochemical plants. Should be able to provide complete design function with minimum supervision. Salary commensurate. Relocation allowance and employer will pay placement fee. For engineering builder. San Francisco. Sj-5653-R.

Sales Engineer, Graduate ChE or ME preferred and some related sales experience. To call on consulting engineering firms, nuclear, missile and ground equipment engineers, constructors of refineries, government facilities, and other engaged in design and production of petrochemicals, pharmaceuticals and airports, etc., for sales of high and low-pressure and temperature filters for all types of industrial service. Considerable travel involved. Expenses paid. Salary open. West Coast. For designer, constructor of filters. Sj-5653.

Production Engineer, ME, with background in machine-shop practice and exposed to production problems of scheduling, quality control, union relations, tooling, and methods improvement, etc. $8400 start and company will pay placement fee. For fabricators and manufacturers of metal products. San Francisco Peninsula. Sj-5652-R.

Designers, graduate or equivalent, minimum three to five years' experience heating, ventilating, air conditioning, and/or plumbing. Must be well experienced and able to perform independently on public and commercial-type work. For consulting-engineering office including schools and hospitals. Able to translate design thinking on board, plan, and specifications. Employer will consider payment of relocation cost and placement fee. $8400–10,800. Headquarters, Sacramento. Sj-5649-R.

Plant Engineer, ME, 27-38. Minimum two years' experience in food processing or allied industry, experience in equipment selection and design, plant layout. Supervise new installations, prepare layouts, estimates, reports, instruct draftsman, prepare specifications on new equipment, plant layout, construction. Salary open. Southern Calif. Sj-5648-R.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME | FIRST NAME | MIDDLE NAME

POSITION TITLE | NATURE OF WORK DONE
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) | Division, if any

*☐

EMPLOYER'S ADDRESS | City | Zone | State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS | City | Zone | State

☐

PRIOR HOME ADDRESS | City | Zone | State

* CHECK "FOR MAIL" ADDRESS

Address changes effective when received prior to:

I subscribe to

- ☐ MECHANICAL ENGINEERING — 10th of preceding month
- ☐ *Journal of Engineering for Power*
- ☐ *Journal of Engineering for Industry*
- ☐ *Journal of Heat Transfer* — 20th of preceding month
- ☐ *Journal of Basic Engineering*
- ☐ *Journal of Applied Mechanics*
- ☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

- ☐ A—Aviation
- ☐ B—Applied Mechanics
- ☐ C—Management
- ☐ D—Materials Handling
- ☐ E—Oil and Gas Power
- ☐ F—Fuels
- ☐ G—Safety
- ☐ H—Hydraulics
- ☐ I—Human Factors Group
- ☐ J—Metals Engineering
- ☐ K—Heat Transfer
- ☐ L—Process Industries
- ☐ M—Production Engineering
- ☐ N—Machine Design
- ☐ O—Lubrication
- ☐ P—Petroleum
- ☐ Q—Nuclear Engineering
- ☐ R—Railroad
- ☐ S—Power
- ☐ T—Textile
- ☐ U—Maintenance and Plant Engineering
- ☐ V—Gas Turbine Power
- ☐ W—Wood Industries
- ☐ Y—Rubber and Plastics
- ☐ Z—Instruments and Regulators

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Dec. 23, 1960, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and Transfers

Arizona

HELDA, ROBERT W., Phoenix
HEMP, MARLY P., Scottsdale
LUCAS, JOHN P., JR., Tucson

California

●BAIRD, EARL D., San Jose
●BROW, EDWARD W., Los Angeles
BUCHERT, KENNETH P., Los Angeles
COURTNEY, JOHN A., San Francisco
HABUSH, ALFRED L., Solana Beach
HAHN, CLAYTON W., Torrance
HEHMANN, ROBERT J., Granada Hills
MUIR, ANDREW, Industry
●NERENSTEIN, WILBUR, North Hollywood
PARKINSON, PAUL K., Monterey Park
PALMER, LUTHER D., Leucadia
●ROBBINS, CHARLES H., Saratoga
ROFF, CLARENCE V., JR., El Cajon
SANGSTER, WILLIAM A., JR., San Jose
SPENCER, EUGENE D., Canoga Park
STARRETT, PHILIP S., Glendale
STONER, HAROLD E., Redwood City
WELCH, MILFRED F., Mountain View
WEST, FRED, San Diego

Colorado

LOPEZ, MANUEL, JR., Wheat Ridge
●THURSTIN, HENRY A., JR., Denver

Connecticut

BREEDEN, DALLAS W., Waterford
CHASE, BARTON, Waterbury
HADENKA, LEON, Torrington
KUO, SHAN S., New Haven
MCGOWAN, FREDERICK J., Middletown
STRAMOSKI, HENRY B., Stanford

District of Columbia

HELT, WILBUR C., Washington
INGRAM, ORVILLE, Washington

Florida

BATTAGLIA, ANTHONY W. G., Jacksonville
COOK, RAYMOND L., Pensacola
HAYS, JOHN K., Coral Gables
KIPPELS, HORACE O., Pensacola

Georgia

CLELAND, CHARLES H., Savannah
LAUDIG, DAVID J., LaGrange

Hawaii

●JOHNSTON, WALLACE D., Honolulu

Illinois

DENNIS, RONALD E., Washington
HACKETT, PRESTBURY T., Chicago
KEDDY, EDWARD S., Richton Park
LEWIS, LAWRENCE N., Chicago
MITCHELL, JOHN E., Morton
SKINKLE, GORDON L., Chicago
SPARING, WILLIAM H., Chicago

Indiana

HERNDON, CHARLES L., Evansville
PATTERSON, ALTON R., Brownsburg
PEAT, DAVID W., Indianapolis
●TRAMONTINI, VERNON N., Indianapolis
●WEISS, ADOLPH L., Indianapolis

Kansas

PARSONS, JAMES L. G., 2nd, Lawrence
VIOLA, BOBBIE E., Enterprise

Kentucky

GRIFFITH, HOWARD D., JR., Owensboro

Maryland

LEDDEN, J. H., Baltimore
●MENNE, DONALD F., Bel Air
WASDYKE, JAMES T., Baltimore
ZARFOSS, JAMES R., Timonium

Massachusetts

BIRKENSTOCK, ROBERT F., Newton Highlands
COOK, NATHAN H., Concord
●DAY, ROBERT W., Amherst
DICKSON, THOMAS, Boston
FIFE, JAMES A., Boston
●MONKMAN, FOREST C., JR., South Braintree
MONSON, DAVID O., Arlington
PRESCOTT, NORMAN F., Wenham
SMITH, ROBERT D., Wellesley Hills

Michigan

●BROWN, DUANE B., Trenton
●DURBETAKI, PANDELI N., East Lansing
EMBACH, EDWARD L., Dearborn

Minnesota

KEYPORT, ROBERT J., St. Paul
MAZOROL, EARL A., JR., Minneapolis
MENTEL, THEODORE J., Minneapolis
SAMPSON, RICHARD L., Hopkins

Missouri

BILLER, GEORGE J., JR., Union
LUTZ, FRED, Kansas City
SCHAFER, THOMAS S., North Kansas City

New Jersey

ASHWORTH, JOSEPH A., East Orange
●CAMPBELL, JOHN F., Port Reading
CARNALI, CLAUDIO J., Stewartsville
GAL, GEORGE, West New York
●JACOBS, ROBERT M., Rutherford
JEROTHE, RUDOLPH A., Wayne
MAXWELL, BRYCE, Princeton
MCPHAIL, JOHN J., Teaneck
●MICHELS, WALTER J., Newark
●NICKERSON, JAMES W., Woodridge
POMEROY, EDWIN C., Chatham
SMITH, DONALD F., Jersey City
THOMAS, LEO, F., Maplewood

New Mexico

COUNTS, JERRY, Albuquerque
MERSON, THOMAS J., Albuquerque
●MILLER, WILLIAM P., JR., Albuquerque

New York

AMOS, JOHN, Syracuse
ANDERSON, WARREN R., Port Jefferson, L. I.
ARAKELYAN, KARNIK B., Forest Hills
ATANASOFF, JOHN V., Webster
●AUBURN, HAROLD J., Rochester
BATSON, ROBERT E., Corning
●BEER, EMANUEL E., White Plains
BURGIN, HOWARD C., Rye
CARROLL, JOHN, New York
CHAPELLIER, ROBERT A., Whitestone
DE WILDE, EMILE F., Tonawanda
●FREUDENSTEIN, FERDINAND, New York
GRIWITZ, ROBERT E., Rochester
HANSCHKE, ALBERT F., Wellsville
HARSANYI, TIBOR, New York
HOPSON, CHARLES K., Williamsville
●KIRSCH, ERWIN R., New York
MARTIAL, JACQUES, New York
MEYER, JOHN M., Scotia
NAGEL, WILLIAM D., Elmira
PARMET, IRWIN L., West Hempstead
PAUL, FRANK W., JR., Rochester
●REDFIELD, DAVID H., Poughkeepsie
RUHOFF, HERMANN V., Brooklyn
RUSSO, ROBERT V., Hopewell Junction
SCIANNA, JOSEPH A., North Babylon, L. I.
SHUFELT, HOWARD C., Rochester
SISTA, LAWRENCE M., Kingston
TITCOMB, STANLEY C., Endicott
TOLCISS, JOSEPH, Fresh Meadows

North Carolina

LONG, MENDALL H., Cary
ROTHROCK, PHILLIP M., Winston-Salem

Ohio

BRUCE, RONALD L., Cincinnati
●HAIGH, LAWRENCE A., Toledo
HARTELUST, JAN W., Akron
●HELMICH, MELVIN J., Mt. Vernon
HORNBURG, CHARLES D., Canton
●KRAMER, EDWARD R., Cleveland
●LOHNES, FRANK G., Mentor
●LONG, WILLIAM F., Brecksville
MINNICH, ROGER A., Ashland
MOOREHEAD, EDWARD A., Mt. Vernon
POTAPCZUK, GEORGE J., Mt. Vernon
REED, NELSON G., Mt. Vernon
SIMON, MARVIN D., Dayton
SPRESSER, PAUL M., Toledo
●VEKICH, STEVE J., Ashtabula
●WRIGHT, DANIEL K., JR., Cleveland
YOST, LAWRENCE L., Alliance

Oklahoma

NEWMAN, RICHARD O., Tulsa

Pennsylvania

COOK, ALVIN G., Brackenridge
COOPER, RAYMOND, Philadelphia
DONOVAN, JOHN R., Erie
●GODFREY, DONALD R., Sharon
●GRIJALBA, ABEL D., Swarthmore
GRISCOM, RODMAN E. 3rd, Philadelphia
IRWIN, CARL P., Athens
KLOPP, JOHN W., Telford
KRAFT, NED O., JR., Schuylkill Haven
LEAHY, ROBERT J., Levittown
●LINDSAY, RUSSELL F., Erie
LOHMEIER, ALFRED, Media
LOOSE, GUENTER H., Bradford
MANDY, ZOLTAN, Easton
MATEJKOVIC, JOHN V., Upper Darby
REYNOLDS, DAVID J., Berwick
●ROSARD, DANIEL D., Havertown
STOESS, HENRY A., JR., Allentown

Rhode Island

HATCH, ARTHUR E., JR., Warwick

South Carolina

BRINEMAN, ROBERT C., Belvedere
●LEWIS, ALEXANDER D., Clemson

South Dakota

●SNYDER, LESTER W., JR., Rapid City

Tennessee

DAVIS, PAUL H., Chattanooga
MCBRIDE, JACK M., Kingsport

Texas

ANDERSON, ROBERT C., Houston
DIETZ, ALVAH E., Borger
●FORDYCE, REX M., Houston
GREASER, ROBERT W., Houston
MEI, HARRY T., Beaumont
●SMITH, EUGENE V., Texas City

Vermont

TUTHILL, ARTHUR F., Burlington

Virginia

NEWBILL, THOMAS C., JR., Covington
REED, ERMEL E., JR., Covington
STUKEL, JAMES J., Covington
VARNER, IRA S., Alexandria

Washington

●COURTRIGHT, DON M., Spokane

West Virginia

●CHADWICK, GEORGE S., JR., South Charleston
GENCSOY, HASAN T., Morgantown

Wisconsin

DAWN, FREDERIC S., Madison
GILROY, ROBERT G., Milwaukee
GRENDA, RONALD J., Milwaukee
HAUGEN, RICHARD A., Wauwatosa
●HOLSEN, HARRY R., Milwaukee
MACDONALD, NORMAN F., LaCrosse

Foreign

ABRAMOV, ISRAEL, Johannesburg, South Africa
●AGNEW, THOMAS C., Toronto, Ont., Canada
AVNERY, NATHAN, Haifa, Israel
BAILEY, ALAN B., Burton on Trent, Staffordshire, England
BANERJIE, ANIL K., Calcutta, West Bengal, India
BASU, SATYAKI, Calcutta, India
CLARKE, NEAL M., Johannesburg, South Africa
FREED, NEVILLE H., Johannesburg, South Africa
HARRIS, FRANK R., Sale, Cheshire, England
●KING, FRANK E., St. Lambert, Quebec, Canada
KOHLSTROM, CURT W., Sandviken, Sweden
●LEACH, ROBERT W., Caracas, Venezuela, South America
MEHTA, AMRITLAL K., Navrangpura, Ahmedabad, India
NATH, PITAMBER, New Delhi, India
STEPHENSON, EDWARD D., Saint John, N. B., Canada
ZAKRZEWSKI, ANDREW S., Toronto, Ont., Canada
ZINSZER, EDWIN J., The Hague, The Netherlands

● Transfer to Member or Affiliate.

OBITUARIES

Lee Leonard Amidon (1897–1960?), professor and head, department of mechanical engineering, South Dakota State College. Born, Clymer, N. Y., Nov. 18, 1897. Parents, Leonard and Cora (Austin) Amidon. Education, BSME, Univ. of Minnesota, 1923; MSME, West Virginia Univ., 1927. Married Ruth Braden,

1932; children, Coralyn Marie and John Leonard. Mr. Amidon was thoroughly qualified in power-plant design with respect to thermodynamic processes, heat transfer, and machine design. He received his earliest training before attending college, as a three-year apprentice in electrical testing with the General Electric School of Technology in Erie, Pa. He worked with an engineering company for a period after graduation, and then accepted a position as assistant professor in the department of power engineering at West Virginia University. In 1937, after 14 years there, he left to become an associate professor of mechanical engineering at the University of Louisville, Louisville, Ky. During this period he also was a consulting engineer in steam power and manufacturing power equipment. He accepted a professorship with the South Dakota State College in 1941, becoming head of the mechanical-engineering department. He also administered the department of aeronautical engineering. He assisted in the revision of the sections on steam turbines, internal-combustion engines, and concrete in the "Coal Miners Handbook." Jun. ASME, 1928; Assoc-Mem. ASME, 1934; Mem. ASME, 1935. He was honorary chairman of ASME student branches at West Virginia Univ., the Univ. of Louisville, and South Dakota State College, since 1924. He was Secretary of the Louisville Section from 1938 to 1941. He was a member of SPEE, South Dakota Engineers and Architects, the National Aeronautic Association, Tau Beta Pi, and Pi Tau Sigma.

Robert Barbour (1886–1960?), retired as president of The Linen Thread Co., Inc., New York, N. Y. Born, Monmouth Beach, N. J., July 5, 1886. Parents, William and Julia Adelaide (Sprague) Barbour. Education, ME, Columbia Univ., 1910. Upon graduating, Mr. Barbour became vice-president of the Barbour Flax Spinning Co., which designed and built special machinery for plants of The Linen Thread Co. He advanced to president in 1915. At the same time, he was general manager of the manufacturing plants of The Linen Thread Co., a holding company comprising 19 plants, and occupied the position of mechanical engineer of the company's 11 American mills. As general manager, he supervised all plant alterations and construction. Mr. Barbour also was a consulting engineer for the Central Locomotive and Car Works, Chicago, Ill., and vice-president of the Parrett Tractor Co., which was connected with the Chicago concern. In 1932 he became president of The Linen Thread Co., Inc. He retired in 1939. Assoc-Mem. ASME, 1916; Mem. ASME, 1924. He was a member of SAE.

Orrin William Barker (1900–1960?), retired vice-president and chief engineer, Kearney and Trecker Corp., Milwaukee, Wis., died, Sturgeon Bay, Wis. Born, Beloit, Wis., July 28, 1900. Education, attended Univ. of Wisconsin. Mr. Barker was with Kearney and Trecker Corp., machine-tool manufacturers, for 31 years, first as a draftsman, then as an engineer, an assistant chief engineer, and chief engineer. Before joining the company in 1925, he worked briefly with Western Cartridge Co., East Alton, Ill.; with Ingersoll Milling Machine Co., Rockford, Ill.; and with Nash Motor Co., Racine, Wis. He retired in 1956. He held several patents. Mem. ASME, 1953. He was a member of SAE, and a registered professional engineer in the State of Wisconsin. He is survived by his wife, Rachel, and his mother, Mrs. H. C. Barker, Waukesha, Wis.

George Kendrick Bringhurst (1893–1959), mechanical and industrial engineer, Anderson, Nichols and Co., Boston, Mass., died, Shore Memorial Hospital, Somers Point, N. J., Sept. 17, 1959. Born, Philadelphia, Pa., May 25, 1893. Parents, Robert Ralston and Fanny (Hodgson) Bringhurst. Education, BS, Pennsylvania State College, 1915; ME, 1935. Married Mildred Scheu, 1918; one son, Neale Clark. Mr. Bringhurst specialized in heating and ventilating. He was with Stone & Webster, Boston industrial engineers, for 17 years before being retired by them in 1958; then he joined Anderson, Nichols and Co. Before starting with Stone and Webster, he had wide experience as a mechanical draftsman. He worked with Philip H. Johnson, Philadelphia architect, on heating and lighting layouts for municipal buildings; with the Juniata Co., Elkton, Md., on reinforced concrete roads; with William Gordon Corp., Bristol, Pa., on shipyard piping; and with Monks and Johnson, Boston, on the design of a government shipyard at Alameda, Calif., a project that was halted in 1918. From 1918 to 1925 he was a draftsman with Albert C. Wood, consulting engineer of Philadelphia, doing mechanical and structural design for power and industrial plants. Among other projects, he helped design a milk-condensing plant for the Hershey Chocolate Co., at Hershey, Pa. He was a mechanical engineer with Philip H. Johnson from 1925 to 1929, on projects involving the Philadelphia Convention Hall and General Hospital, county prisons, and state armories. He began organizing his own consulting business in 1929, which he ran until he joined Stone & Webster 12 years later. He was with them until his death, except for one year on special assignment with the Corps of Engineers, U. S. Army, in 1955. Assoc-Mem. ASME, 1921; Mem. ASME, 1927. He was a member of the Massachusetts Society of Professional Engineers, and NSPE. He authored a number of articles on heating published in *Heating and Ventilating* and other technical magazines, and was business manager of the *New England Professional Engineer* from 1949 to 1955. He was a registered professional engineer in Pennsylvania, New Jersey, and Massachusetts, and the province of Ontario, Canada.

Harry August Feldbush (1893–1960), retired vice-president, Worthington Corp., Harrison, N. J., died, Orange Memorial Hospital, Aug. 28, 1960. Born, St. Louis, Mo., June 11, 1893. Education, attended Westminster College, Fulton, Mo.; BS(ME), Washington Univ., 1915. Mr. Feldbush was with Worthington Corp., since 1915, when he started with Henry R. Worthington, St. Louis, in the sales department. Several months thereafter, he was transferred to experimental work at the firm's plant in Cincinnati, and four years later was a research and test engineer at the same plant. There he became general superintendent in 1923, and works manager in 1925. Subsequent advancement made him associate manager of the Buffalo, N. Y., works, and general manager of the Refrigeration Division at the Harrison works. In 1940 he was elected a vice-president of the Worthington Pump and Machinery Corp., as the company was then called, and made his headquarters at Holyoke, Mass., as manager of the Holyoke works. Five years later he was appointed vice-president in charge of all engineering of parent and associated companies. He had made his office at Harrison, N. J., before retiring. He authored a paper on compressor testing, and was issued a number of patents. Assoc-Mem. ASME, 1917; Mem. ASME, 1950. Surviving are his wife, Mrs. Carmel Kennedy Feldbush; two sons, John and Harry A., Jr.; a daughter, Mrs. Guy a Martz, Jr.; and three grandchildren.

Emil Frederick Fernes (1907–1960), assistant manager, Maryland Casualty Co., Baltimore, Md., died, Sept. 9, 1960. Born, Philadelphia, Pa., Aug. 29, 1907. Education, graduate, Baltimore Polytechnic Institute, 1953. A specialist in boiler and pressure vessel inspection, Mr. Fernes was assistant manager of the company's boiler and machinery department, directing the work of supervising engineers and machinery inspectors, and advising engineers on ASME and state codes. He had previous experience as an operating and test engineer with Cramp Shipbuilding Co., Philadelphia, Pa., 1941–1946; and with Heintz Mfg. Co., Philadelphia, 1946–1947, on boiler operation. He joined Maryland Casualty Co., in 1947 as a boiler and machinery inspector. He held commissions to inspect boilers and pressure vessels from the National Board of Boiler and Pressure Vessel Inspectors, and from various states. Assoc. Mem. ASME, 1954.

Arthur P. M. Fleming (1881–1960), electrical engineer and retired director, Metropolitan-Vickers Electrical Co., Ltd., Manchester, England, died at his home on the Isle of Wight, Sept. 14, 1960. Born, Newport, Isle of Wight, Jan. 16, 1881. Education, MS, Finsbury Technical Institute, London. Sir Arthur Fleming, who was knighted in 1945, conducted research that contributed to the development of radar. He received the medal of the Order of the British Empire for work on submarine detection in World War I. He lived in the United States from 1900 to 1902, while employed by Westinghouse Electric Co., Pittsburgh, Pa., and was largely responsible for insulation design there. Before coming to this country, he had been with the London Electric Supply Corp. He returned to England to work with British Westinghouse Co., now Metropolitan-Vickers Electrical Co., Ltd., Manchester, as an insulation specialist. Then he was made head of the transformer department with responsibility for the design of all transformers manufactured by the company. He gave up transformer work to become manager of the then proposed research department, and was solely responsible for founding, organizing, and administering this department. In World War II, he advised the Cabinet on scientific matters. He authored many articles for the technical press. Mem. ASME, 1928. He also was a member and past-president of AIEE, and a member of ASTM. He served several terms as president of sections of the British Association for the Advancement of Science.

Earle William Gard (1894–1960), vice-president, The Ralph M. Parsons Co., Los Angeles, Calif., died, Jan. 25, 1960. Born New Burlington, Ohio, March 29, 1894. Parents Charles William and Cora Leuvinia (DeWolfe) Gard. Education, BSEE, Univ. of Southern California, 1917. Married Marguerita Grace Dinsmore, 1917; children, Earle William, Jr., and Lura Maree. Mr. Gard joined Bechtel-McCone-Parsons Corp., engineering and construction firm, as vice-president in 1941, becoming a consultant in 1946. A petroleum specialist, he had previous experience with several oil companies. After serving as an inspector and engineering officer in the U. S. Navy from 1917 to 1919, he went with the Union Oil Company of California, Wilmington, on development and test work. He left there in 1923 to join the Pan American Western Petroleum Co., as assistant chief engineer and assistant refinery manager. Later he returned to the Union Oil Co., as a development engineer, and advanced to manager of research and development, but left again in 1941 to join Bechtel-McCone-Parsons Corp. He was responsible for several inventions in the petroleum industry, and was given a special assignment by the government, in connection with the U. S. Strategic Bombing Survey, on oil, chemicals, and rubber in Japan. Mem. ASME, 1951. Member also, ACS, ASCE, AICE, SAE, and API. He was a registered mechanical, civil, and chemical engineer in the State of California.

Olen Randall Garett (1918–1960?), draftsman, Douglas Aircraft Co., Inc., Long Beach, Calif. Born, Taft, Calif., Sept. 25, 1918. Parents, Mr. and Mrs. Roy Garrett. Education, BS, Univ. of California, Berkeley, 1940. Mr. Garrett was a draftsman with North American Aircraft, Inc., Inglewood, Calif., and Vultee Aircraft, Inc., Downey, Calif., before he joined Douglas Aircraft. Assoc. Mem. ASME, 1940.

George Walter Hawkins (1882–1960?), sales engineer. Born, Woolwich, England, July 7, 1882. Parents, George Walter and Caroline E. Hawkins. Education, attended California School of Mechanical Arts. Married Ella R. Kennedy, 1928; one daughter, Helen A. Mr. Hawkins specialized in the design, cost, and economy of steam power plants, with special reference to oil fuel. He was with Charles C. Moore and Co., engineers of San Francisco, Calif., as a draftsman and mechanical engineer, from 1903 to 1918. He was appointed manager of the firm's office in Tucson, Ariz., in 1913. While employed by them, he had charge of the design of numerous complete steam power plants in California and Arizona. In 1918 he went to Shanghai, China, as chief engineer with Andersen Meyer and Co., Ltd., subsequently helping to design and construct 43 power and industrial plants throughout China. Thereafter, from 1925 to 1933, he was a sales and industrial engineer for several firms, and in 1933 became vice-president in charge of sales with Crew Levick Co., Philadelphia, Pa. He authored the book "The Economy Factor in Steam Power Plants," published by McGraw-Hill in 1908. Mem. ASME, 1913.

Thomas Francis Kuzara (1915–1960), mechanical engineer, Thiokol Chemical Corp., Huntsville, Ala., died, July 12, 1960. Born, Pittsburgh, Pa., July 16, 1915. Education, BS(ME), Univ. of Pittsburgh, 1949. Mr. Kuzara was with the Joy Mfg. Co., Franklin, Pa., as a senior draftsman on mining machinery, before joining Thiokol Chemical Corp., where he worked in the Redstone Division. Assoc. Mem. ASME, 1950.

Frederick William Midgley (1875–1960), retired mechanical engineer, died, St. John's Riverside Hospital, Yonkers, N. Y., Sept. 3, 1960. Born, Jersey City, N. J., July 5, 1875. Education, ME, Cornell Univ., 1898. Mr. Midgley joined the engineering staff of the Otis Elevator Co., in 1900 and retired in 1939. He started there as a draftsman, advanced to a position as engineer and, in 1905, became chief draftsman. He helped develop most of the electric elevator equipment of his day, including furnace and bell hoists, escalators, and electric-controlling devices for ammunition hoists on battleships. Assoc. Mem. ASME, 1904; Mem. ASME, 1914. Surviving are a son, Fred W. Midgley; three daughters, Mrs. Lillian Smith, Mrs. Mary Davis, and Mrs. Ruth Furrie; a sister, Mrs. Alice Spreckelson; seven grandchildren; and three great grandchildren.

William James Moore (1878–1960), retired professor of experimental engineering, Polytechnic Institute of Brooklyn, died, Paul Kimball Hospital, Lakewood, N. J., Aug. 29, 1960. Born, Metuchin, N. J., Sept. 19, 1878. Education, graduate, Stevens Institute of Technology, 1900. After graduating as the highest ranking scholar in his class, Professor Moore taught at Brooklyn Polytechnic for 35 years, and at one time also taught at the North Carolina A&M College. While teaching at the latter institution, he also was in charge of the electrical installation for a new central power station, as well as electrical and physics labs. During World War I, he served as a consultant to the U. S. Government, devising wind tunnels and systems for testing propellers. He invented numerous mechanical devices and was until his death a consultant for the Ford Motor Co. At one time a consultant to the City of New York, Professor Moore set the city standards for concrete building blocks. Mem. ASME, 1918. Surviving is his son, John B. Moore.

Charles Edward Morrow (1896–1960), assistant superintendent of building planning, Defense Projects Division, Western Electric Co., Inc., New York, N. Y., died, Aug. 6, 1960. Born, Champaign, Ill., Nov. 13, 1896. Education, BS(ME), Univ. of Illinois, 1924. A power specialist, Mr. Morrow started his career as a superintendent for a heating and ventilating contractor. Before obtaining his first position with Western Electric Co., in 1927, he also did mechanical design for the University of Illinois, and power-plant design for the Illinois Central Railroad, Chicago. For two years he did similar

work for Western Electric, and then was made assistant superintendent of buildings for Ohio State Univ., where he was responsible for the design and purchase of new power-plant equipment. In 1936 he was again with Western Electric as a mechanical engineer, and eight years later was systems-service engineer for the company, also having charge of building alterations on leased properties in Nebraska and Minnesota. Later positions with the company included operating the Hawthorne Station power plant, Chicago, and directing power-plant alterations at the station. Mem. ASME, 1950. He was a registered professional engineer in Illinois.

Perry Ira Nagle (1898–1960), president, Nagle Pumps, Inc., Chicago, Ill., according to a notice recently received by the Society, died, February, 1960. Born, Memphis, Mo., Dec. 26, 1898. Parents, Jacob Willard and Emma Belle (Boyle) Nagle. Education, BS(ME), Univ. of Illinois, 1922. Married Merle Turner, 1925; children, Patricia Ann and James. After graduation, Mr. Nagle went to work with the American Manganese Steel Division of the American Brake Shoe Co., as manager of pump sales. Many years later, in 1954, he became a consultant on pumps, having designed and patented some of his own pump designs for industrial use. Known as AMSCO-NAGLE pumps, the designs were developed by Mr. Nagle outside company employment, and later were assigned to the company and placed under his personal sales management. Mem. ASME, 1944. Member also of AAAS and Tau Beta Pi. He was a registered professional engineer in Illinois.

Charles B. Paddock (1872–1960), retired engineer of Medford, Ore., died, Aug. 3, 1960. Born, Cleveland, Ohio, May 31, 1872. Parents, John Gibbons and Anna (Nevin) Paddock. Education, correspondence and private study. Married Cleo Weber, 1934; one daughter, Mrs. Evelyn Paddock Smith. At the age of 12, Mr. Paddock began a six-year machinist apprenticeship that took him into several companies. In 1891, his apprenticeship finished, he was engineer of tests and chief inspector for several steel companies, including the Illinois Steel Co., Chicago, the Wellman Iron and Steel Co., Thurlow, Pa., and the Carpenter Steel Co., Reading, Pa. Seven years later he was field and assistant chief inspector for the Hartford Steam Boiler Inspection and Insurance Co., and several others, designing boiler and steam plants; and in 1908 became chief inspector, western superintendent, and manager for the company in Oregon, Washington, and California. He held the position of department manager until his retirement in 1945. Mem. ASME, 1921. He was a consultant on the early edition of the ASME Boiler Code. He was a member of the Chicago board for examining engineers, a member of the Chicago committee for smoke prevention, and a technical adviser to the Industrial Accident Commission in Oregon.

Everett William Palmquist (1911–1960), project engineer, Union Tank Car Co., Chicago, Ill., died, July 16, 1960. Born, DeKalb, Ill., July 20, 1911. Education, attended Univ. of Indiana and Chicago Technical College. Mr. Palmquist joined the Union Tank Car Co., in 1929. From his initial position as a blueprint operator and tracer, he advanced to senior draftsman in 1934, assistant to the chief draftsman in 1946, and chief draftsman in 1948. His work involved leasing and maintaining tank cars for petroleum products. Jun. ASME, 1952.

Alfred Edwin Poulsen (1910–1960), owner and president, A. E. Poulsen and Co., Los Angeles, Calif., died, March 4, 1960. Born, Paso Robles, Calif., Oct. 4, 1910. Education, BA in Production Engineering Univ. of Southern California; DS. Mr. Poulsen organized his own company in 1940, specializing in designing and manufacturing general mill equipment, including numerous complete plants in California and Arizona. He gained the experience for this enterprise by working as an assistant and chief engineer with McKain Mfg. Co., from 1934 to 1939. He did plant layout and design of feed mills, fertilizer plants, and grain elevators, among other projects. During his last year with the company, he was in complete charge. As sole owner of his own organization, he designed and manufactured whole plants for a number of companies, including an alfalfa-grinding plant in Nevada; a seed-cleaning plant, a feed plant, a chile-grinding plant, a seaweed-dehydrating plant, and several insecticide plants in California; and some bulk storage elevators in Arizona. Mem. ASME, 1949. He was a registered mechanical engineer in the State of California.

Esteban Gertman Roth (1912–1959?), assistant professor of engineering, San Jose State College, San Jose, Calif., died a year ago, according to a notice received recently by the Society. Born, Csongrad, Hungaria, 1912. Education, Ingenieuk degree, Deutsche Technische Hochschule-Beno, Czechoslov, 1936; MS(ME), Univ. of California, Berkeley, 1957. Mr. Roth also was partner and chief engineer with Empresa Constructors Bartos y Cía Boliva, La Paz, Bolivia. Assoc. Mem. ASME, 1958. Surviving is his wife, Ena.

William Frederick Ryan (1908–1960?), owner and chief engineer, Ryan Engineering Co., Salina, Kan., died according to a notice recently received by the Society. Born, Lincoln, Kan., Sept. 20, 1908. Parents, Frederick George and Julia (Mulloy) Ryan. Education, attended American School, Chicago, Ill., and Kansas Wesleyan Univ., Salina. Married Irene Bachofer, 1935; children, Patrick William and Mary Irene. Mr. Ryan entered the engineering profession while still in his teens, doing general plumbing for a home-town firm, and eventually developed a successful career in the field of mechanical installations. In his early twenties, he became a mechanical engineer with The Lee Hardware Co., Salina, Kan., and worked on several major projects, including the Hadley Memorial Hospital, Hays, Kan. In 1938 he joined the Salina Supply Co., becoming chief engineer there in 1943. His work included designs for the Beloit Municipal Building, Beloit, Kan., several schools, and the Kansas Power and Light Co. building. Between 1942 and 1943 he also did work with Wilson and Co., engineer-architects of Salina, as a mechanical engineer on projects that included Hobbs Air Force Base; and was briefly associated with Burns and McDonnell Engineering Co., Kansas City, Mo., where he worked on designs for Smoky Hill Air Force Base and Camp Phillips. After six years as chief engineer with Salina Supply Co., he left to form his own company. Among his projects were designs for such structures in Kansas as the Riley Elementary School, Great Bend; the Dickenson County Court House and the Eisenhower Museum, Abilene; and hospitals in Fort Scott, Newton, and Junction City. Mem. ASME, 1955. He was national director of NSPE from 1957 to 1960; director, 1950–1952, 1956–1957, and vice-chairman of the Kansas Engineering Society; vice-president and president of SPE, Kansas; president of Salina SPE; and a member of the Engineers Club of Kansas City, and ASHRAE. He was engineer in charge of utilities for Kansas Civil Defense.

Leif Stephenson Solsnaes (1894–1959), professor, Norwegian Institute of Technology, Trondheim, Norway, died, December, 1959. Born, Trondheim, June 29, 1894. Education, MS(ME), Norwegian Institute of Technology, 1918. After obtaining his degree, Mr. Solsnaes worked in the institute's water-power machine laboratory on turbine and pump testing. He also taught hydraulics and turbine and pump design. As an assistant engineer, he was of service during the same period to the turbine and pump industry and water-power plants in Norway, as well as those of other countries. In 1925 he became test manager in the laboratory, while continuing as a consulting engineer on the planning, designing, and testing of hydraulic machinery for state and municipal institutions and private firms. He advanced to the post of professor of mechanical engineering at the institute in 1941. He authored several publications, among them a 500-page book, "Design of Machine Members," published in 1941. Mem. ASME, 1949. He was a member of the Norwegian Association of Chartered Engineers. He is survived by a son, Leif Solsnaes, Jr.

George Franklin Starbuck (1873–1960?), whose death was recently reported to the Society, was a retired mechanical engineer. Born, Waltham, Mass., June 14, 1873. Parents, Alexander and Ella Maria (Warren) Starbuck. Education, SB, Massachusetts Institute of Technology, 1897. Mr. Starbuck made his career with railroad companies as a design and mechanical engineer. He started as a draftsman with the Boston and Maine Railroad at Concord, N. H., and in 1902, after being transferred to the office of the chief draftsman in Boston, engineered the successful rebuilding of two locomotives, one of which required a new boiler design. During this time, some previous research work he had done on the deformation of boilers under pressure, was published in *The American Engineer and Railroad Journal*. After traveling for a time in Europe, he returned to this country and took a drafting position in New Haven, Conn., with the New York, New Haven, and Hartford Railroad. He left that company in 1910 to work with the Boston Elevated Railway, Boston, Mass., where he was soon made foreman of the mechanical drafting room. He directed the design of several special cars, and inspected new equipment. He left this position in 1922 to become the leading draftsman with the Boston and Maine Railroad. He authored several technical articles, some of which, concerning the design of brake heads and stresses in locomotives at high speed, were published and drew critical praise. He held patents on railroad rolling stock. In 1904 he was granted a patent on a locomotive buffer that later became the basis of the radial buffer. He was retired in Waltham, Mass. Jun. ASME, 1901; Mem. ASME, 1923. He worked on the ASME Subcommittee on Locomotive Springs. He was a member of AAAS and the New England Railroad Club.

Darrell H. Tornblom (1926–1960?), whose death was recently reported to the Society, was a field engineer, Installation and Service Engineering Division, General Electric Co., Salt Lake City, Utah. Born, Severance, Colo., Aug. 17, 1926. Education, BS(ME), Univ. of Denver, 1950. Assoc. Mem. ASME, 1950. He is survived by his wife.

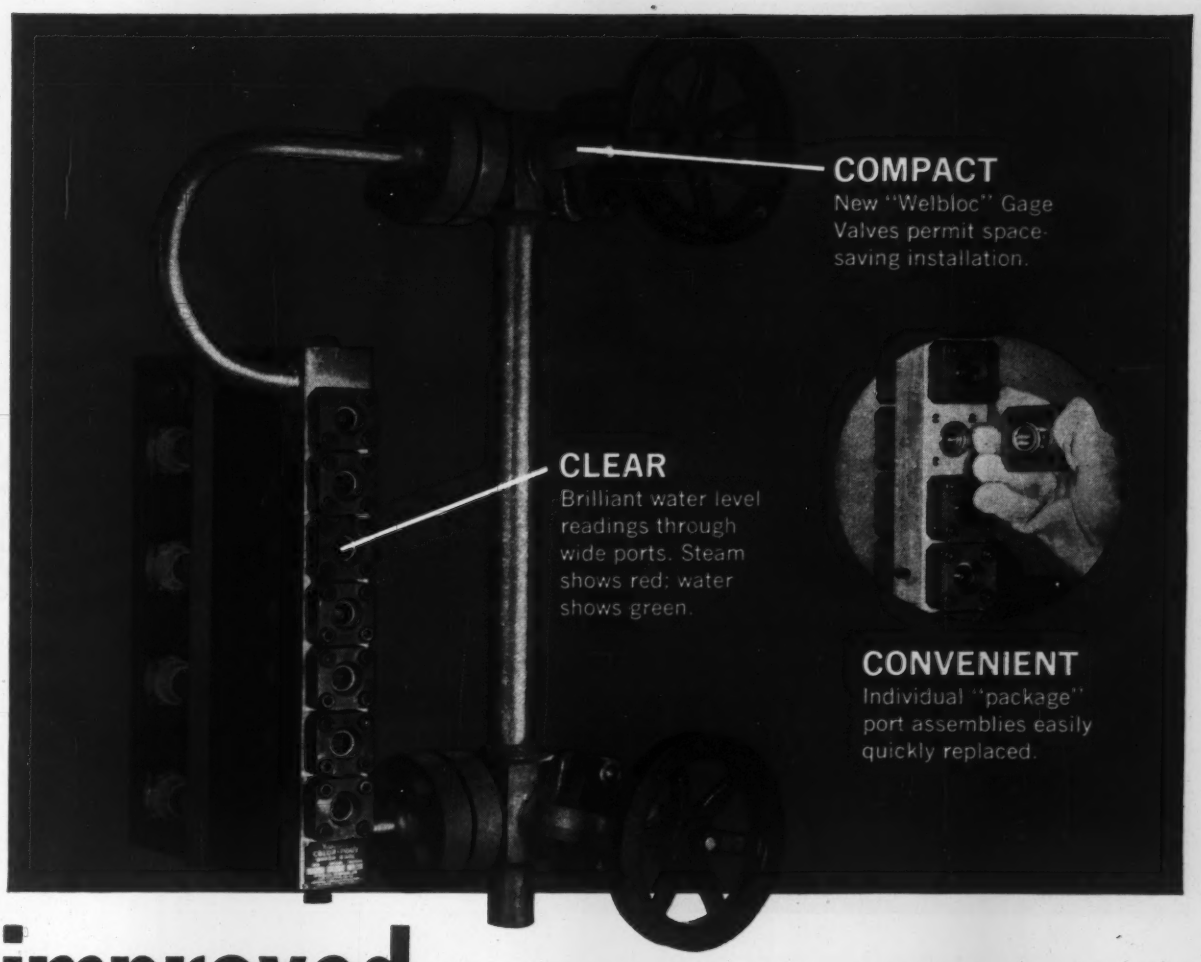
Joseph Benjamin Walczak (1933–1960), junior engineer, Machinery Designers, Inc., Hoquiam, Wash., died, June 28, 1960. Born, Aberdeen, Wash., Nov. 23, 1933. Education, BS(ME), Univ. of Washington, 1955. Assoc. Mem. ASME, 1955. He is survived by his wife.

Philip H. Weinberg (1894–1960), sales engineer, Philadelphia Electric Co., Philadelphia, Pa., died, Aug. 19, 1960. Born, Philadelphia, Jan. 31, 1894. Parents, Louis and Fanny (Hope) Weinberg. Education, BS, Pennsylvania State College, 1915; attended U. S. Naval Academy, Annapolis, Md. Married Ruth C. Klein, 1926; children, Donald Hope and Faye Hope. Mr. Weinberg was with Philadelphia Electric Co., since 1917, beginning as a designer of substations and generating stations. Several months later he joined the U. S. Navy, attended a special course at the U. S. Naval Academy, and became an engineering officer aboard the *USS Zeelandia*. He resumed his career with Philadelphia Electric in 1919, successively becoming an estimation and cost engineer of the station construction department, an industrial salesman, and a senior salesman. He acted as a contact man between his company and major industrial plants, making steam and electrical studies of oil and steel refineries, shipbuilding and locomotive works, and textile mills. Mem. ASME, 1932. He was a member of the Pennsylvania Electric Association, and the AWS.

Arthur Cutts Willard (1878–1960), president-emeritus of the Univ. of Illinois, died, Urbana, Ill., Sept. 12, 1960. Born, Washington, D. C., Aug. 12, 1878. Parents, Alexander D. and Sarah Cutts Willard. Education, SB, Massachusetts Institute of Technology, 1904; DE, Case School of Applied Science, 1934; LLD, George Washington Univ., 1934; LLD, Northwestern Univ., 1934; LLD, Univ. of Illinois, 1946; LLD, Univ. of Maine, 1946. Married Sarah Lamborn, 1907. A specialist in ventilation and air conditioning, Dr. Willard was credited with perfecting the system for ventilating New York's Holland Tunnel. After leaving M.I.T., he taught for a time at the California School of Mechanical Arts, San Francisco, and George Washington University, and was a practicing engineer when the University of Illinois called him to its faculty in 1913. He became head of the mechanical-engineering department there in 1920, and acting dean of the college of engineering and acting director of the engineering experimental station in 1933. He was president of the university from 1934 to 1946. While he was advancing in the faculty, he also was making himself a first-rank expert in heating and ventilation, especially in the fields of heat transmission, steam flow, and warm-air heating. As a consultant, he served the U. S. Government in its army camps during World War I, in the Bureau of Mines, 1921; the Chemical Warfare Service, 1926; and the U. S. Public Health Service, 1927. He also served on the Educational Policies Commission of the National Education Association in 1936, and was a consultant on ventilation of the Chicago subway in 1930. Later he also was consultant on the ventilating system for New York's Lincoln Tunnel. When the engineering college's deanship at the University of Illinois fell vacant in 1933, he consented to serve as acting dean for one year only. On July 1, 1934, he became the university's seventh president when the term of Dr. Arthur H. Daniels as acting president expired. He was made president and professor-emeritus in 1946. He authored several books and numerous papers. With L. A. Harding, consulting engineer and Fellow ASME, Dr. Willard was co-author of "Mechanical Equipment of Buildings," first published in 1916. Mem. ASME, 1919. He worked on the ASME Committee on National Defense. He was president of ASHRAE in 1928, and received the society's F. Paul Anderson Gold Medal in 1936. He held membership in the Society for Promotion of Engineering Education, the National Warm Air Heating and Air Conditioning Association, and the Illinois Society of Engineers. He belonged to many fraternities, among them Sigma Xi, Tau Beta Pi, Sigma Tau, and Pi Tau Sigma. He also was a member of the Illinois Society of Engineers, the Chicago Engineers' Club, and the Division of Engineering and Industrial Research of the National Research Council. He was a member of the Civilian Advisory Council to the Military Training Division, Ordnance Department, in 1942. Surviving is his wife.

Richard Coleman Yager (1921–1960), design engineer, Convair Div., General Dynamics Corp., Fort Worth, Texas, died, April 25, 1960. Born, Fort Smith, Ark., Aug. 11, 1921. Education, BS(ME), Univ. of Arkansas, 1955. Assoc. Mem. ASME, 1955.

Gerson Zweighaft (1935–1960), thermodynamics engineer, Republic Aviation Corp., Farmingdale, L. I., N. Y., died, July 22, 1960. Born, the Bronx, N. Y., Nov. 7, 1935. Education, ME, City College of New York, 1958. Mr. Zweighaft had been with Republic Aviation Corp., since his graduation. Assoc. Mem. ASME, 1958. He is survived by his wife, Frances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The plumbing, heating, air conditioning, fire protection and sanitation facilities of this city-like project are as hard-working as they are complex. Valves with extra-stamina were needed for control of the piping system. Every possible protection against troubles and the high costs of valve maintenance and replacement was demanded. It was obtained with the specification so often written for tough, critical jobs . . . *"valves to be* JENKINS".

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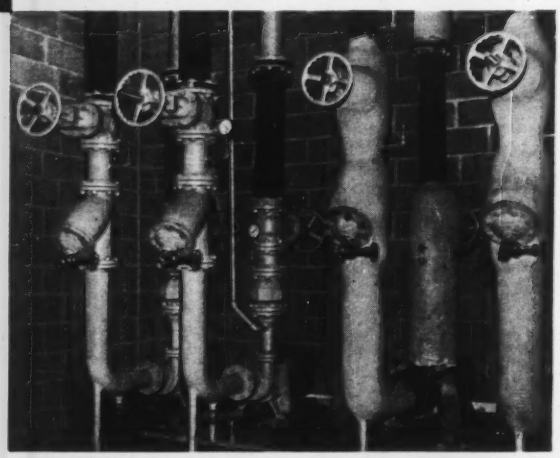

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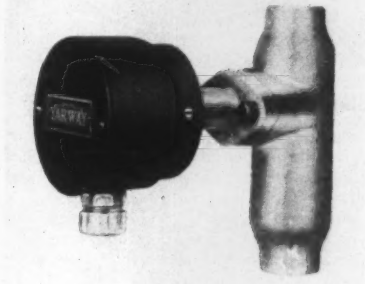


Sensing Device

Yarnall-Waring Co. is offering a sensing device for detection and control of process variables. It employs the unique, patented W-I-T (wire-in-tube) element for transmitting motion through a pressure-tight wall without bellows, seals, or stuffing boxes.

The W-I-T element consists of a flexible, curved tube containing a spring wire. Deflection of the end of the tube by a change in level, flow, or other variable causes rotation of the wire, which in turn may indicate the change or operate a switch.

A variety of applications of this method of transmitting motion through a pressure-tight wall is possible. For example, sensing of changes in level, flow, temperature, density, and so forth, for purposes of indication or control, also leakproof transmission of rotary motion. Application inquiries are invited. —K-1

Socket Screws

As one more step in the planned policy of product expansion and service to industry, Parker-Kalon, originators of the tapping screw and manufacturers of a comprehensive line of industrial fasteners, have announced another new line of socket screws featuring a self-locking plastic insert.

This is not a replacement but a companion to the present P-K socket-screw line. Distributors will be able to supply P-K fasteners in the full line of socket-head cap screws, set screws, flat heads, button heads, shoulder screws, or pipe plugs, with or without the new insert. —K-2

Multiple-Speed Transmissions

The use of subminiature electromagnetic clutches in the speed transmission designs of Autotronics, Inc. makes it possible to have: (*a*) Instantaneous changes between predetermined speed ratios, (*b*) manual or automatic selection of speed ratios, (*c*) remote control of speed changes, (*d*) light weight and compact design.

These multiple-speed transmission units consist of two or more gear trains with friction-disk electromagnetic clutches inserted between them. The desired speed ratios are produced by energizing one or more clutches to couple the gear trains in appropriate combinations. The extremely fast response time of the Autotronic clutch makes the speed changes instantly. Since the clutches are controlled electrically, speed changes can be made automatically by a sequencing switch or a programmer, as well as manually with push buttons. Furthermore, they can be controlled remotely by a direct wire hook up or through a telemetering system. A light-weight and compact design package is achieved by utilizing certain gears and gear trains for more than one speed ratio.

The units can be used to best advantage where light weight and compactness are required, as for example in computers, instrument mechanisms, and control mechanisms. Autotronics is currently in production on the 2, 4, 15, and 30-speed units with various speed ratios for both high and low speeds. They are available from stock in limited numbers or they can be designed and manufactured to customer packaging requirements. Class IV high-precision gears are used on the two-speed model and Class I precision gears are used on all others. —K-3

Motor Mounts

All-steel Equi-Poised motor mounts have been developed by the Falk Corp. for mounting motors directly to the steel frame of Falk shaft-mounted, flange-mounted and screw conveyer drives in the $^1/_2$ to 30-hp range.

These rigid all-steel weldments are predrilled to accommodate all rerated NEMA foot-mounted motors within the rated capacity of the reducers, thus eliminating the expense ordinarily required to design and construct motor bases and foundations. Used with Falk shaft-mounted drives, the balanced design results in zero reaction from belt pull at headshaft bearings—thus actually reducing bearing loads on the driven machine. Adjusting screws provide a quick and convenient method of tensioning V-belts. Ask for Bulletin 7100. —K-4

Boiler Feed Pump

Fully automatic Pacific Type BFI DS boiler feed pumps are equipped with bottom-intake and bottom-discharge nozzles. Made by Pacific Pumps, Inc., two of the pumps have been supplied for California Edison's Huntington Beach Station.

One full-capacity main pump is used with each boiler and driven through a fluid coupling by the main generating turbine at 3510 rpm. Pump capacity is 3865 gpm, with suction pressure of 120 lb and 328-F water temperature. —K-5

Self-Lubricating Bearings

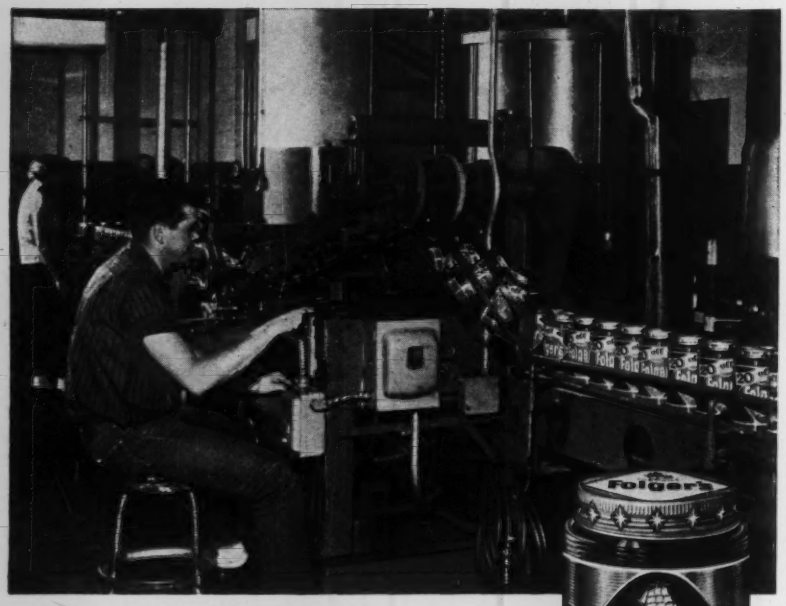
Rod ends, either male (external) threaded, or female (internal) threaded, and plain spherical bearings are available from the Heim Co., when specified, lined with Du Pont Teflon woven fabric.

These bearings with Teflon bearing surface provide all the advantages of high load ratings inherent in this type of single-ball bearing—self alignment, simplicity of assembly, plus the long-wearing, low-friction, self-lubricating, high-impact properties of the TFE fluoro-carbon fiber. Inseparable bonding of the fabric to the substrate and a positive mechanical interlock between the Teflon liner and the outer member of the bearing insure against float or break-away. A wide range of sizes and materials is available. —K-6

Slip Rings

Another new slip-ring assembly is specifically designed to withstand extremely high vacuums and the intense radiation of outer-space conditions, by Slip Ring Co. of America. A 72-ring assembly, it contains both power and signal circuits. The dielectric material, a proprietary development, is the result of years of research and study of materials and processes.

Prototype units have undergone thousands of hours of simulated-space-condition testing, and production units are performing very efficiently in the Midas satellite. —K-7



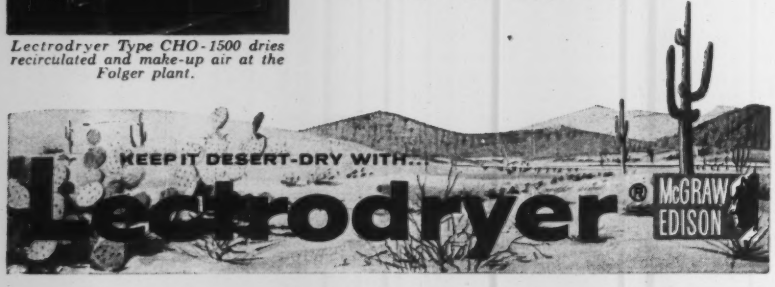
Dry air speeds packaging ...protects quality of instant coffee

Instant coffee absorbs moisture fast. If this happens before it reaches the coffee cup—say when it's being packed—it can clog up packaging machines, ruin the quality of the coffee. In Houston, where humidity stays high for long stretches, the makers of Folger's coffee solved the problem by installing a Lectrodryer that keeps relative humidity at 25% to 35%.

Controlled dryness by Lectrodryer has been the answer to many problems caused by moisture; gumming up of hygroscopic powders, corrosion of metal, air line freezeups, and contamination of drugs, chemicals, liquids, gases.

Lectrodryer Type CHO-1500 dries recirculated and make-up air at the Folger plant.

For a Guide in Planning your own drying system, write for Lectrodryer's Case History Sheets, which give details on how many of these problems were solved. Tell us where you're having trouble with moisture. Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pennsylvania.



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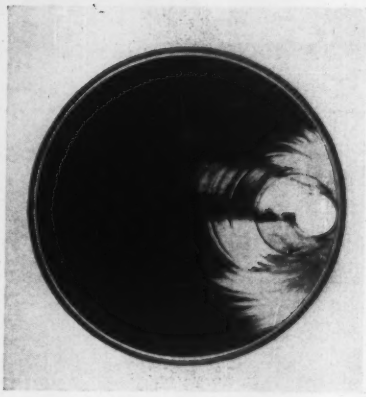

Bimetallic Pipe

Advances in the manufacture and use of bimetallic pipe have been announced by Gray Tool Co. Bimetallic pipe provides all the fabrication and strength advantages of a carbon-steel system, combined with the corrosion resistance of the best alloy materials, and at a fraction of the cost of solid alloy piping.

In the Gray process, a seamless lining is hydraulically expanded into the base pipe, forming the lining tightly against the inside of the base-pipe material. Additional pressure expands the base pipe, and on return to normal operating pressure, the lining is firmly held against the base pipe due to differential contraction.

By using this system, the choice of materials for bimetallic pipe is virtually unlimited. Usually, the base pipe is standard carbon steel in regular pipe sizes and schedules, but the base material can be varied to meet any particular need.

Linings are most frequently furnished in monel, nickel, and stainless steel—but the selection is in no way limited. All the alloys of copper and nickel as well as the reactive metals can be economically produced. Selections of linings can be made on the basis of quality of corrosion resistance, availability, and ease of fabrication.

The variety of corrosion-resistant lining materials available and the small amount required makes practical the use of materials that would be too expensive for solid-alloy systems.

The extreme range of materials available makes bimetallic pipe ideal for all applications where corrosion is a factor. It is equally well suited for use in applications where product contamination or catalyst poisoning are problems.

Gray bimetallic pipe can be fabricated almost as easily as carbon-steel materials. It can be butt welded, flanged, and bent without damage to the lining or the bond between the lining and base material. —K-8

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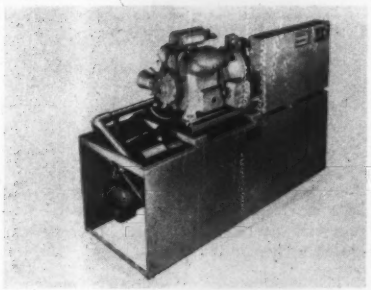

Liquid Chillers

A new line of hermetic, packaged liquid chillers for air-conditioning or industrial-cooling applications is available for American-Standard Industrial Div. Designated the Versare line, it has been designed with emphasis on versatility, compactness, ease of servicing, and safety.

The chillers are available in 11 models for net rated capacities up to 67.1 tons, depending upon condenser-water temperature conditions and desired leaving chilled-water temperature.

The package design is complete, requiring only a minimum of water piping and electrical connections to be made in the field. Unusual compactness in the new units has been aimed at slimness sufficient to permit passage through a 36-in. doorway.

Hermetic compressor construction eliminates problems associated with field alignment of compressor and electric-motor drive. With no shaft seal, maintenance problems and refrigerant leakage are greatly reduced.

Protection for the compressor is provided in the form of a cooler evacuation circuit and crankcase heaters. These features combine to prevent large quantities of refrigerant from accumulating in the cooler or crankcase during inoperative periods, thus eliminating start-up problems. —K-9

Plastic Sheeting

A new methyl methacrylate monomer has been introduced by the Polychemicals Dept. of the Du Pont Co. specifically for the production of cast acrylic sheets for the sign and lighting industries. It is being offered to sheet casters under a new trademark, Monocite methacrylate monomer—H 100. Easy to clean and inexpensive to maintain, Monocite sheeting is impervious to all kinds of weather and will not yellow. It weighs only a third as much as glass, has high impact strength, even at low temperatures, and resists chipping, cracking, and crazing. Stability is retained at temperatures as high as 200 F.

Sheets can be thermoformed and such postforming fabrication processes as sawing, drilling, punching, threading, routing, heat welding, and cementing are also possible. —K-10

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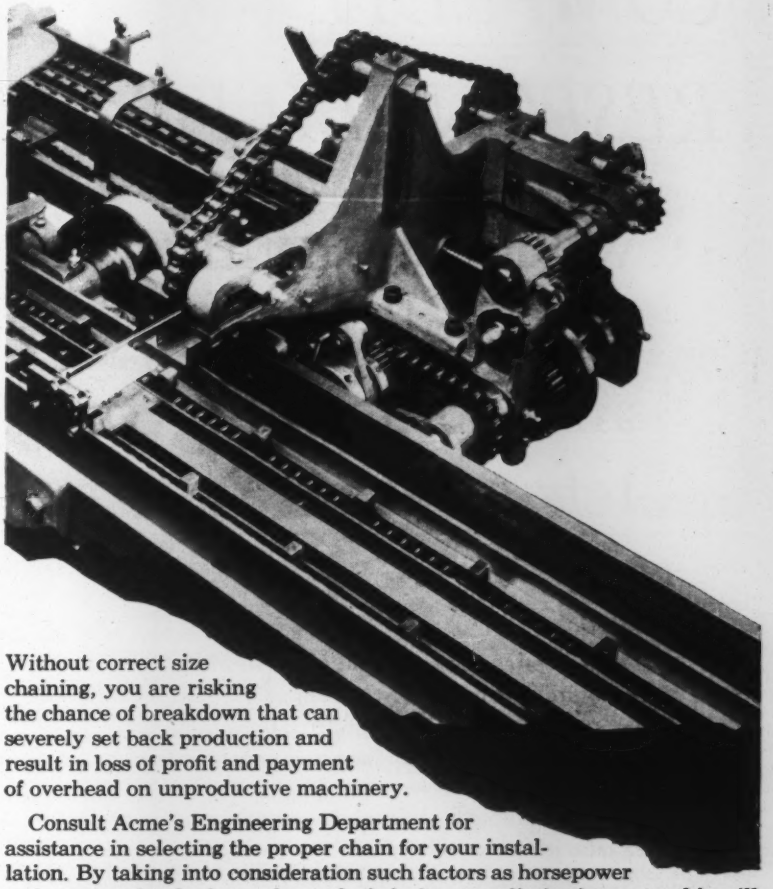

Without correct size chaining, you are risking the chance of breakdown that can severely set back production and result in loss of profit and payment of overhead on unproductive machinery.

Consult Acme's Engineering Department for assistance in selecting the proper chain for your installation. By taking into consideration such factors as horsepower to be transmitted, size and speed of shaft, space limitations, etc. this will determine the standard size of chain required to do the job best. This size or any other can be obtained off-the-shelf from your local Industrial Distributor.

Your Industrial Distributor can supply you promptly with Acme Roller Chains in 12 standard sizes from ¼" pitch to 2½" pitch. He has the full cooperation of our Engineering Department. Contact him.

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Clutch-Brake Pot Module

A new design concept in the application of electromagnetic control to the operation of potentiometers has been under development at Autotronics, Inc., for some time. The design of the Pancake clutch-brake, currently in production, was predicated upon the requirement for a shorter unit capable of delivering almost the same performance of the previous precision clutches, brakes, and clutch-brake combinations.

The combination of the electromagnetic clutch-brake with a potentiometer has resulted in a unique unit having several distinct advantages over any component, or combination of components heretofore available. The new combination consists of a clutch-brake unit with a special end cap that becomes the potentiometer mounting plate and part of the housing. The complete assembly is a single, permanently sealed unit with a common shaft and integral bearings. Since this clutch pot is a single unit, the problems of coupling backlash, shaft misalignment, end play, and excessive bearing drag are eliminated.

The basic construction of the clutch pot consists of a Pancake clutch-brake unit with extra-length shaft and a potentiometer winding cup coupled to the clutch-brake unit by means of a special machined-end cap. The output shaft of the clutch-brake unit is the rotating shaft of the potentiometer upon which is assembled the wiper arm of the pot. Since this shaft is one single piece, there is no problem of coupling error or alignment error. The bearing bore and the winding-cup mounting recess are machined to extremely close tolerances so that there is no chance of eccentricity causing faulty operation. The elimination of the coupling has also allowed the use of smaller masses in this unit which in turn make the entire assembly less susceptible to the forces of high-g loads.

The reduction of the mass of the movable elements of the system now allows the designer to place these units in the planes that are most advantageous to the reliable operation of the potentiometer and disregard the possible effect of g loading on the clutch itself. Extensive evaluation of the new electromechanical components has shown that shock and acceleration forces in excess of 100 g have no effect on performance. Installation, servicing, and testing are greatly simplified by the single unit. Reduced physical size of the clutch-pot unit allows the design of a much more compact system which extends the user a more rugged unit at less weight. The field logistics of the spare-parts program is also simplified to the extent that the stock lists and number of parts are reduced. This reduction in quantity of spares required is reflected in lower accounting costs and the smaller space required for spare-parts stock. —K-11

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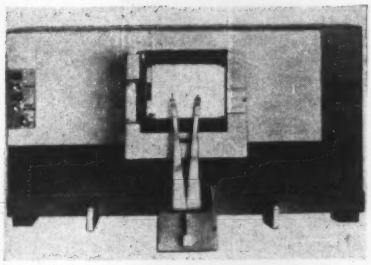

Chart Integrator

A chart integrator for use with American strip charts and conventional instrument round charts has been introduced by American Meter Co.

The integrator provides three values from a single run. It not only computes the chart extension for differential and static pressure, but also provides read-out values for the average absolute static pressure and the average differential pressure. The American chart integrator handles both American strip charts and conventional round charts by means of a simple adaptor plate supplied with the instrument.

It has been developed for greater efficiency in chart interpretation and for ease of operation with reduced eye strain and fatigue. Records are easy to check as follower pens superimpose a light ink line on the original chart record. —K12

Engineering Desk

A multipurpose engineering desk, made by Hamilton Mfg. Co., adaptable to individual use as well as complete departmental installations, provides a $43\frac{1}{2} \times 72$-in. linoleum drawing surface with roll-holding brackets to simplify handling of large drawings. It converts instantly into a spacious office desk and supplies two files to accommodate every filing requirement. Files may be used independently of the board if desired.

The entire assembly consists of three basic parts—a steel, linoleum-covered top and two files and can be assembled in minutes without tools. Simple to handle, easy to move, it saves time and space for industries which require flexible engineering facilities. All components are constructed of steel for dependable performance and long life. —K-13

Carbon-Graphite-Source Identification

Once carbon-graphite parts had been placed in operation it was impossible to identify the manufacturer. The properties of such parts depend primarily on whether the carbon graphite was obtained by pulverizing natural graphite; heating anthracite coal or organic materials; the combustion of petroleum, natural gas, or hydrocarbons; etc. Even the source of the raw material—natural graphite, coal, wood, charcoal, coke, petroleum, gas, etc. will influence these properties. Heating and reheating in fabrication continually carbonizes the hydrocarbon binder. For these reasons, it has been impossible to develop a meaningful specification for carbon-graphite made by various producers from different materials, and to identify parts after they had been used. The U. S. Graphite Co. has now developed a positive-identification method which even tells the specific grade of carbon graphite supplied.

User complaints or the improper operation of carbon-graphite parts can now be traced directly to the supplier. —K-14

Semidry Sensitized Papers

A full line of semidry diazo sensitized papers is available from the Ozalid Div. of General Aniline and Film Corp. The new materials have been developed for both engineering-drafting-room use and office copying and are interchangeable with present moist diazo materials.

Marketed under the trade name of Ozafax, the new line includes: standard-weight, $20\frac{1}{2}$-lb papers in four different speeds; lightweight, 17-lb papers in four different speeds; beater-dyed papers in six different colors and in Super Rapid-X speed; an intermediate paper; developers; and corrector solutions. The papers are of the semidry developing alkaline type which are almost universally used for the moist diazo process. —K-15

High-Tensile Alloy-Steel Bar

A contribution toward still higher strength levels in steel parts without heat treating and the attendant knotty production problems and high costs has been made by La Salle Steel Co. with the introduction of "e.t.d." (elevated-temperature drawing) 150 Alloy Steel Bar.

Guaranteed minimum tensile strength is 150,000 psi, and guaranteed minimum hardness is R_c 32, yet machinability compares with other alloy steels of similar hardness. It has been successfully roll-threaded, and provides satisfactory finish and tool life.

The "e.t.d." 150 is a 4100 series, 40 per cent minimum carbon, alloy-steel bar. It represents an extension of the line of steel bars made by La Salle's exclusive and proven "e.t.d." process. The first of these high-strength materials, Fatigue-Proof, was introduced five years ago. In this process the steel bar is drawn at preselected temperatures significantly above room temperature, but below the lower critical temperature. Because of the individual processing of each bar and the inherent process characteristics, exceptional uniformity and control of properties are achieved.

Available in rounds $\frac{7}{16}$ through $3\frac{1}{2}$ in., "e.t.d." 150 alloy-steel bars are recommended for shafts, gears, pinions, fasteners, axles, and other parts to replace heat-treated alloy steels. Tolerances range from 0.005 in. in the smaller sizes to 0.008 in. in the larger. Bar stock may be ordered in either standard "as-drawn" finish, or ground-and-polished finish. Strength is uniform throughout the bar. —K-16

MANY FAST'S HAVE BEEN WORKING LONGER THAN YOU

It's a fact. There are plenty of cases where Fast's Couplings have been in service 20 to 40 years. And some of our more enthusiastic engineers say a Fast's should last forever if it's properly applied, installed and lubricated. Whatever opinion you accept, you can bet Fast's Couplings will give you the same smooth-running, low-maintenance, long-lived performance that makes them the choice of more equipment manufacturers than any other gear-type coupling.

For example, Fast's Coupling No. 1347, shipped in July, 1922, is still in service—and the customer is just ordering his first spare coupling 38 years later.

KOPPERS COMPANY, INC., 512 Scott Street, Baltimore 3, Md.

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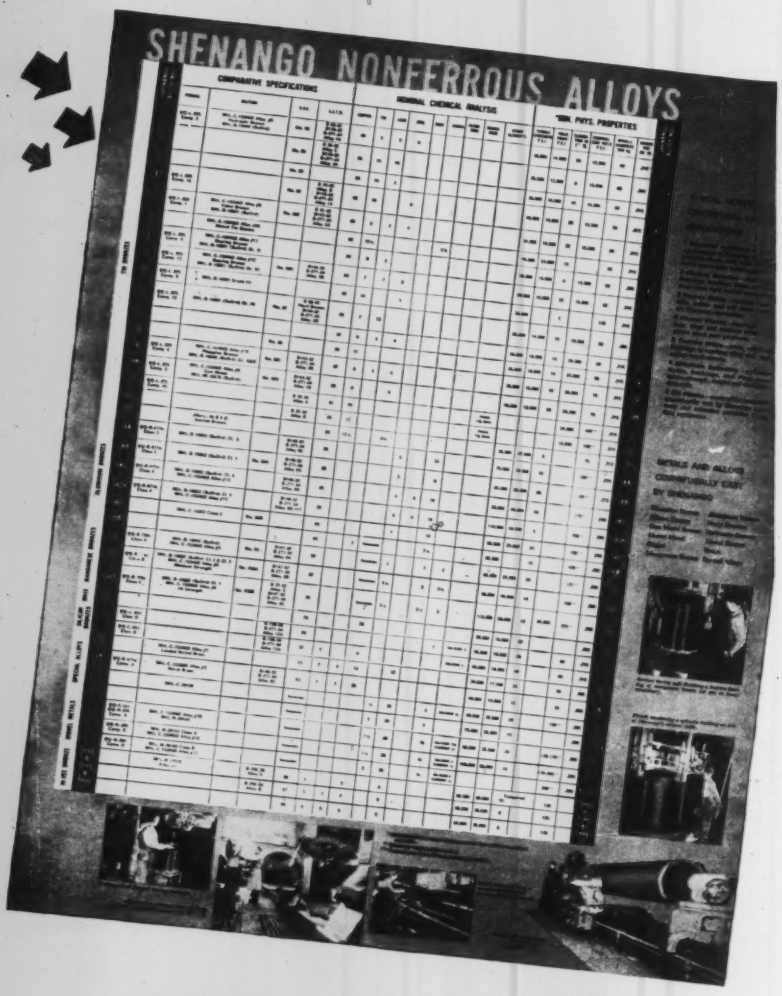

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Transmissions and Universal Joints

Twin Disc Clutch Co. has announced plans for the expansion of its product line to include power-shift transmissions and universal joints. This will enable the company to offer original equipment manufacturers a complete "engine-to-axle" line of power-transmission components. Furthermore, Twin Disc is enlarging its research and testing facilities to develop the control systems which actuate and govern converter-transmission operations.

The new transmission is a five-speed-forward, one-speed-reverse unit, designed for engines developing up to 420 net hp at speeds up to 2100 rpm. Designated Model TA-51-2001, it is a straight-through countershaft type with constant-mesh gearing and oil-cooled, hydraulically-actuated clutches.

A new 18-in. single-stage torque converter with freewheeled stator, hydraulic retarder, and lock-up clutch is also in production. The converter and transmission will be furnished as a package unit or if preferred, for independent transmission mounting.

Scheduled for production in early 1961 is a new line of universal joints, now in the design and prototype-testing stage.

Capacities will range from about 2000 to 5000 lb per ft of torque. —K-17

Back-Pressure Regulators

Sliding-gate back-pressure regulators in 4 and 6-in. sizes are now available from OPW-Jordan. These new line-operated valves have capacities of 50,000 lb per hr of steam or 2500 gpm of water. Sliding gate and plates used in both the pilot and main valve give accurate regulation, tight shut off, and minimum maintenance. The self-lapping and self-cleaning seats cut costs and provide better control over plant operations. The entire system or main valve and pilot alone can be purchased from OPW-Jordan. The system is suitable for pressures to 250 psig and temperatures to 500 F. The main valve is available in cast iron with 125-lb ASA flanges, or ductile iron with 150 or 300-lb ASA flanges. The pilot is a standard screwed-end control valve with special seats. —K-18

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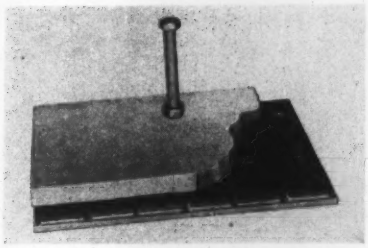


Machinery Mount

Heavy-duty mount, Series HM, made by Barry Controls is designed for isolating shock and vibration from exceptionally heavy, high-capacity metal-forming equipment—mechanical and hydraulic presses of 200-ton capacity and above.

Each Barrymount consists of a suitable number of individual Type 297 Barry isolators to carry the required load. These isolators are secured between a common base plate and a top plate, which is drilled and tapped for a tie-down bolt. Each serialized HM mount is custom designed for the particular machine and pit.

Like standard leveling Barrymounts, the vibration-isolating medium is neoprene, available in various stiffnesses to meet individual requirements for minimizing vibration transmitted to the floor. Twelve basic sizes of the series HM mount are available, covering load ratings of 16,000 to 128,000 lb per mount.

The Heavy-duty mount is the third of a series of new developments in machinery mountings which have been added to the standard Barry line of leveling mounts and spring mounts this year. —K–19

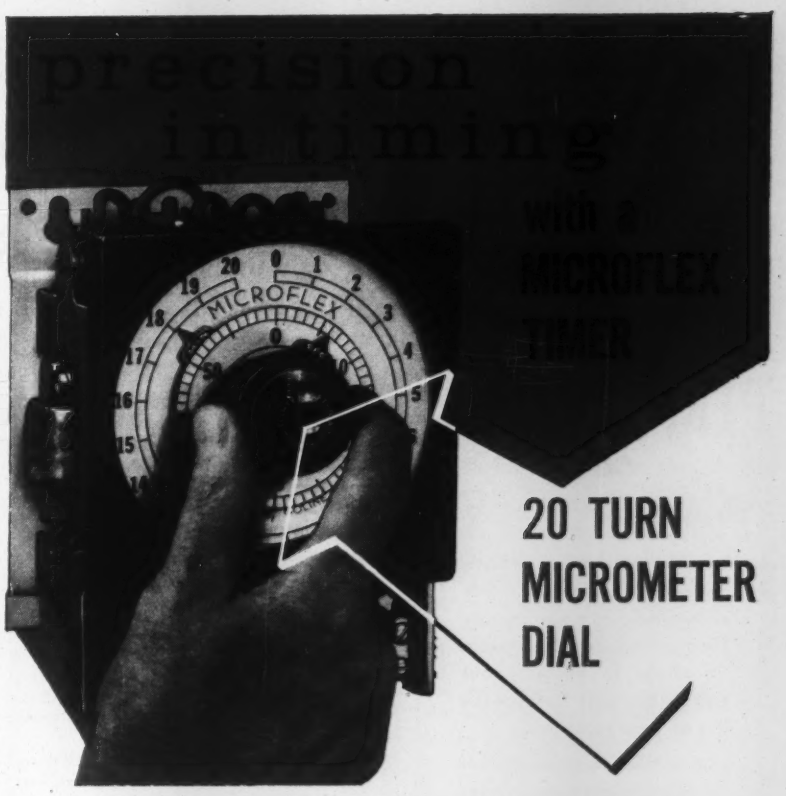
Stressproof Steel Bars

Many new-parts applications will be opening up for users of Stressproof steel bars, now available from La Salle Steel Co. in diameters up to 4 in. round. The same high physical properties are held in the new larger sizes—high strength without heat treating, 100,000-psi yield—is maintained. This is strength equivalent to many heat-treated steels, although parts do not have to be sent to a commercial heat treater or the user's own heat-treating department.

When used in place of most other steels of equivalent strength, Stressproof is claimed to increase machining rates from 50 to 100 per cent, and is rated at 83 per cent of B1112.

Warpage is also held to a minimum, reducing or eliminating entirely the need for expensive straightening operations. Better wearability is claimed than that of many heat-treated carbon and alloy steels. Ask for Bulletin No. 15. —K–20

For Consulting Engineers Turn to Page 178



20 TURN MICROMETER DIAL

The EAGLE Microflex Timer provides unequaled accuracy in closing or opening a circuit. An easy-to-read 20 turn double micrometer dial speeds the selection of new settings over full 7200° range and permits a one-glance check of previously set intervals.

- PIN-POINT ACCURACY is possible with 1200 conveniently spaced dial markings. No guessing at in-between points. Accuracy maintained by patented pinion and threaded axle.
- 9 DIFFERENT ACTIONS are available for each of 3 SPST 15 ampere contacts which can be selected according to circuit requirements.
- PLUG-IN COMPONENTS allow rapid replacement of timers. Large capacity contacts eliminate additional load relays.

OTHER POPULAR HIGH QUALITY EAGLE TIME-COUNT CONTROLS

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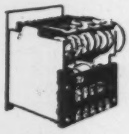
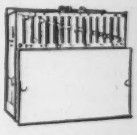
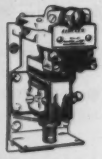

CAM TIMERS


MULTI-CIRCUIT TIMERS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NO BACKLASH

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- Visual Inspection While in Operation
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Actuator Test Stand

An actuator test stand, capable for the first time of testing both linear and rotary actuators, has been produced by the Garrett Corp. AiResearch Mfg. Div.

Previously, two test stands, twice as expensive, were required to test linear and rotary actuators. However, the new AiResearch test stand eliminates this duplication.

The AiResearch unit is basically a hydraulically operated, energy-absorbing device designed for load testing and calibrating linear and rotary actuators now in current use on aircraft and missiles.

The new, highly accurate actuator test stand is capable of linear measurements of ±0.006 in.; ±10 min in rotary measurements; and ±2 per cent of force measurements.

In testing linear actuators the stand measures rated loads in tension or compression, readout of applied load, stroke length for electrical and mechanical stop adjustment, actuator end play, and jam tests.

For rotary actuators, the unit measures rated torque loads, readout of applied load; rotation for electrical and mechanical stop adjustment; and actuator backlash.

The stand tests linear actuators which have a maximum 21-in. extended-length accommodation; a retracted length of 3 in.; a stroke length of 10 in.; and applied dynamic load of 10 to 1000 lb.

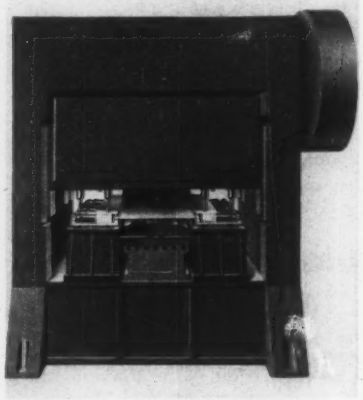
It tests rotary actuators which have applied torque (reversible) of 15 to 750 lb and static torque load (reversible) of 0 to 750 lb-in. **—K-21**

Flexible Coupling

Lifetime lubrication, ease of operation, and permanent durability are claimed for a newly designed American jaw-flange flexible coupling manufactured by Mechanical Power Transmission Div. of Zurn Industries, Inc.

A specially-designed oil-impregnated center member is made of sintered steel. Through unique capillary action, the center member absorbs and retains high-grade lubricating oil for long periods and dispenses it to bearing surfaces as needed.

The newly designed unit not only maintains all the misalignment capacity characteristics inherent in standard American jaw-flange flexible couplings but has greater torque and load-carrying capacity with attendant longer life. **—K-22**



Stretch-Forming Attachment

The Cyril Bath Co., manufacturers of radial-draw forming machines used in the production of aircraft, jet engines, and guided missiles, has developed a stretch-forming attachment for standard draw presses. The principle consists primarily in stretching metal independently and prior to the die-forming operation. Movement of the press brings the prestretched sheet down over the die while almost simultaneously and immediately behind this, the upper die comes down upon the lower die finishing the work. Any tendency of trapped metal to wrinkle is removed by the action of the hydraulic stretch heads.

The attachment has the advantage of giving adequate stretch to the metal while completely eliminating the need for a draw ring for holding the stock.

In die costs, up-keep and set-up time, the savings have been as high as two thirds of present expenditures. Savings of 20 per cent in the metal are possible by using a lighter and less expensive sheet stock and elimination of metal held under the hold-down ring.

The process also produces a far stronger and harder part due to the prior stretching. The process is equally applicable to aluminum alloys, stainless steel, titanium, and other thermal-resistant alloys which cannot be worked in conventional die operations. In many cases, heating the material before forming is eliminated. **—K-23**

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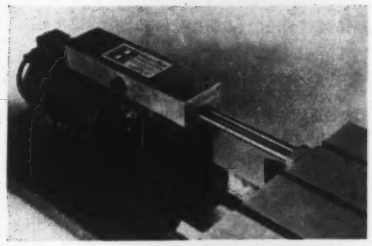

Multiple-Positioning Control

A new electrical-mechanical servo device called the Hanna-Powr positioner automatically positions machine tools, valves, float levels, doors, hoppergates, and similar devices at any of several predetermined positions, corresponding to a control-selector switch signal.

Developed by Hanna Engineering Works, the positioner is used for remote operation of various types of power mechanisms such as air or hydraulic cylinders, along with solenoid valves applied to operate pipeline flow valves. The valve or other device may be miles from the control office. A return read-out signal light indicates when the predetermined position has been achieved.

The Hanna-Powr positioner Model PR 2A has two cam rods, and a connecting link on one end is attached to the mechanism the positioner is controlling. The other two ends of the steel cam rods trip limit switches as the cam rods slide back and forth inside the two channel grooves in the extruded-aluminum positioner housing.

There may be as many as 14 different positioning stops per foot in the positioner. The positioner may be made in various lengths up to 8 ft long as standard.

The location of the predetermined stop-position stations can be easily changed by loosening two adjustment screws on the limit switches and moving the sets of limit switches.

Positioning accuracies of ±0.005 in. depend upon the mass and weight of the load or type of application. The positioner is not designed for extreme instrumental accuracies.

This positioner can also be used with a two-directional motor in conjunction with a reversing relay to operate many different types of devices. —K-24

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Nema-Matched Pumps

Adapt-Able centrifugal pumps, designed to furnish a wider range of clear water, non-clog, and other liquid modifications has been introduced by Fairbanks, Morse & Co. Each pump is NEMA-matched; that is,the pump dimensions align with those of NEMA-rated motors for ease of mounting and trouble-free operation. The Adapt-Ables are constructed so that the pump frames receive various size volutes and impellers. Thus, each individual pump becomes, in effect, the equivalent of several individual units.

Because of standarization with NEMA motor-frame dimensions installation can be made without makeshift height-adjusting blocks and odd-bore couplings. Maintenance and conversion are made more quickly and easily, on-the-spot. The need for parts inventories is reduced, since even the bearings of pump and motor are interchangeable.

The Adapt-Able design permits the most economical frame size to be selected to match the motor horsepower requirements of the pumping job. In vertical pumps the Adapt-Able design offers splitcase advantages—rotating elements are separated as a unit, simply by removing a few bolts connecting the adapter to the volute, then lifting the assembly free.

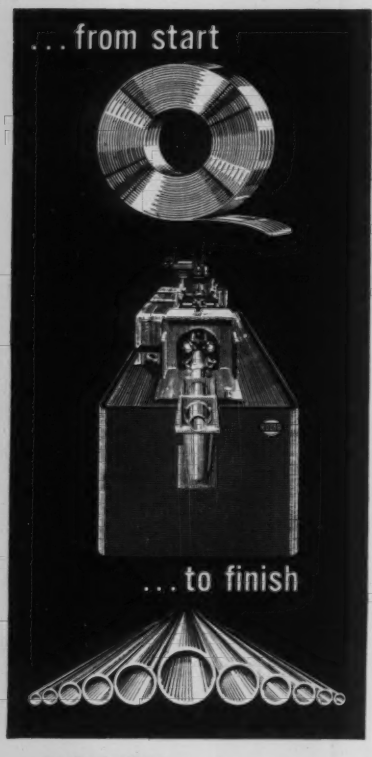
Both conventionally-mounted horizontal and vertical pump and motor units are available as well as the F-M "biltogether" construction. Both horizontal and vertical Adapt-Ables feature cartridge-type mechanical seals or conventional stuffing boxes, with easy factory or field changeover to suit pumping requirements. The Adapt-Able vertical pumps are constructed so that stuffing boxes can be repacked, bearings adjusted, or rotating elements removed without disturbing inlet and outlet pipes, regardless of whether the pipes contain sewage, industrial wastes, or solids in slurry.

The Adapt-Ables are also useful for an impressive variety of liquid-handling modifications—for corrosive liquids, solids in suspension, nonabrasive materials such as bottle labels, leaves, feathers, or other small solids in general pumping service or on original equipment. —K-25

Thermostat Anticipator

A new more efficient thermostat anticipator is being used on Electrofilm's high-watt-density heating elements where accurate and instant temperature control is imperative. The thermostat is enveloped by the heating element itself which results in instant and accurate heat control with little or no time lag. In designing this thermostat anticipator Electrofilm, Inc., has eliminated costly calibration and expensive thermocouple signal-amplifying equipment.

This new design causes the thermostat to operate at the same temperature as the heating element during the transient and allows the thermostat to be either in series with the heating element or where the heater's current would exceed the capacity of the thermostat it can be in series with the field of a relay. In addition, the cost of temperature controls on Electrofilm's surface-type heating elements are greatly decreased. The anticipator allows for easy installation and removal of the thermostat. —K-26



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Double Shut Off Coupling

A double shut-off quick coupling, made in either steel or brass, for handling gases and industrial fluids is being manufactured by the Breco Div. of Perfecting Service Co. Known as the Series G it has a two-way check valve that stops the flow from both lines with minimum fluid loss when making or breaking the connection.

Fast, easy, one-hand Pushomatic locking action forms a positive high-pressure leak-proof connection simply by being plugged in. The patented locking mechanism locks automatically without turning or twisting. A large flow chamber permits maximum flow. Swivel action prevents hose tangling and kinking, permiting the hose to hang in a natural curve for easier handling.

The couplings are made of steel or brass in 1/4, 3/8, 1/2, and 3/4-in. NPT pipe sizes, with working pressures up to 8000 psi. **—K-27**

Door Heaters

Heaters which stop cold drafts through plant shipping doors when they are open, and supplement the plant heating system when doors are closed, have been developed by L. J. Wing Mfg. Co. They automatically provide a high-velocity curtain of warm air when a door opens. When the door closes a damper is automatically repositioned for discharge of warm air at normal velocity, to provide either room or perimeter heating under room thermostat control.

They are available in ten sizes for mounting heights to 22 ft and floor-area coverage up to 60 × 132 ft mounted for room heating, or 33 × 180 ft mounted for perimeter heating. Steam or hot water may be used as the heating medium. **—K-28**

Safety Switch

A motion safety switch, described as almost foolproof, which protects machines, equipment, and processes against damage resulting from stoppages has been announced by the Fuller Co.

The safety switch is especially useful for stopping a machine serving another. It will thus prevent damage from pyramiding by limiting repairs to those necessary to correct the original cause of the stoppage. It may be used to control a motor circuit or to operate a warning device, such as a signal light, horn, or bell.

The Fuller Motion Safety Switch is designed to be driven by any machine or equipment the continuous operation of which is essential to the safety and proper operation of related equipment or processes. It is 9 1/2-in. high and 9 1/2-in. wide and can be driven in either direction at 40 or 100 rpm.

Movement of a hinged leaf (6) is caused when a vane (4) falls to an idle position. It actuates a micro switch (7) either to open or to close a circuit, as desired. **—K-29**

Glass-Fiber Tubing

The Reinforced Plastics Div. of the A. O. Smith Corp., pioneers in the development of filament-wound glass epoxy products for the electrical industries, has announced a customer tooling plan which will result in substantial savings for electrical users of its glass-fiber products.

The cost-saving program includes utilization of standard tooling for 27 of the most popular major ID sizes of round Red Thread glass-fiber tubing. These 27 sizes will be available without added cost to the user. In the past, the customer customarily assumed cost of these tooling charges.

The 27 standard sizes include the most popular ID sizes in the 1/2 to 6-in. range with wall thickness ranging from 0.03 to 11/8 in. Lengths are available up to 20 ft.

In addition, the division will continue to offer special sizes of Red Thread tubing in round, square, and rectangular shapes on a custom basis.

Electrical uses include plain and combination tubing for fuse tubes, fuse cores, bus-bar tubing, solenoid frame spacers, and coil forms.

A. O. Smith originally manufactured Red Thread glass fiber tubing exclusively for dip tubes for its Permaglas water heater, producing more than 6 million ft for that purpose alone. It is also being installed for salt-water disposal in the oil fields. **—K-30**

Sound-Level Meter

A fully transistorized, battery-operated sound-level meter weighing only 4 lb with patented, high-impedance input, is being produced for the Korfund Co., by Dawe Instruments, Ltd.

The Type 1400E—a self-contained acoustical instrument—features exceptional accuracy, stability, and sensitivity, giving direct readings of sound-pressure levels over the entire audio range from 24 to 140 db, on its 5-in-wide meter dial. Its transistors virtually eliminate microphonics, and provide superior calibration and amplifier stability.

The sound-level meter, which conforms to ASA and proposed IEC specifications, has a Rochelle-salt crystal, diaphragm-type microphone which folds into a recess in the case. The mike feeds into a patented impedance-matching circuit followed by a high-gain amplifier, an 11-position attenuator, calibrated in 10-db steps, and ASA-standard weighting networks. The meter will accommodate all 600-ohm-impedance passive, and any active, filter networks.

The instrument is powered by 3 dry cells, good for 60 operational hr, or by an external 115 to 230-volt, 60-cps source. The unit measures 8 1/4 × 5 3/4 × 3 3/4 in., and is supplied in a leather carrying case. **—K-31**

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Ball Valves

A line of ball valves, made of the toughest grade of Type 1, unplasticized polyvinyl chloride, is available from Hoke Inc. The PVC compound used meets the proposed new ASTM specification, and has a tensile strength of 8500 psi. This type of PVC has the strength and resistance required for extensive corrosive chemical service.

A new molding process permits the production of ball valves from this unplasticized PVC that are dimensionally stable with very high impact strength. Nontoxic, nonflammable, and almost completely nonaging, this PVC valve can be heat welded, or solvent bonded right in the line for maximum integrity. Another interesting feature is its temperature range, which permits service to 140 F. The valves have been rated at 125 psi, and their extreme light weight makes them ideal for use on long, unsupported spans of plastic and other pipe.

Designed with Teflon seats, Hoke's PVC ball valves give full flow when open and are completely leak-tight (at the seats and at the stem) when closed. The valves can be cleaned, and the seats and packing can be replaced without removing them from the line. Positive stops indicate the full-open and full-closed positions. Installation is simplified by its coupling-like assembly which permits each half of the valve to be fitted to the pipe ends, and then reassembled.

Initially, the valves are offered in $\frac{1}{2}$, $\frac{3}{4}$, and 1-in. sizes; all NPT female connections. Larger sizes will be available soon. —K-32

Magnetic Starters

Cutler-Hammer has introduced a compact Size-5 starter in an extension of its three-star line of magnetic starters, already available in Sizes 00 through 4.

Representing the smallest Size 5 currently offered by a major manufacturer, maximum dimensions of the Cutler-Hammer device are: width, 13 in.; height, $15\frac{5}{16}$ in., and an especially shallow depth, $6\frac{1}{8}$ in. The C-H Size 5 can be mounted in an enclosure only 8 in. deep.

The unique contact structure of Cutler-Hammer's Size 5 minimizes bounce, heating, and wear. Parallel double-break contacts provide four contact points to easily accommodate the heavy current surges associated with Size-5 applications. For accurate overload protection, epoxy-cast current transformers and low current overload relays are used.

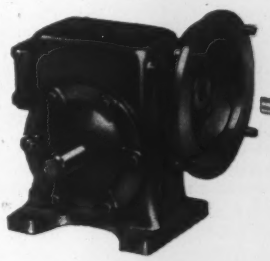
The new Size 5 also features an internal holding circuit interlock, and up to four additional interlocks can be added in the field. Circuit arrangements available are normally open, normally closed, and normally closed late opening.

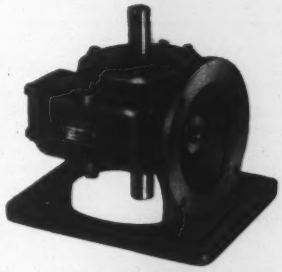
Other features incorporated into the design are unitized construction, straight-through wiring, and removable lugs for easier installation. —K-33

956 different motorized speed reducers

available from stock

Yes! 956 different combinations of Perfection Motorized Worm Gear Speed Reducers are available for immediate delivery, *from stock*. Ratios range from 5 to 1 to 60 to 1, in capacities from 1/6 H.P. to 5 H.P. Perfection "C" Flange Reducers may be ordered complete with motor or without motor, to be used with a motor *of your own choice.*





Flanged motor reducers offer the maximum in compactness, rigidity and adaptability. Through the use of standard NEMA face mounted motors, complete interchangeability between motors is provided. Motor maintenance is possible without disturbing the drive and reducer. Motor assembly is fast and positive with no alignment problems.

Write for your free copy of our new 28 page catalog containing illustrations, charts and tables to help you choose the right Reducer for your particular application. Ask for Bulletin No. M-140.

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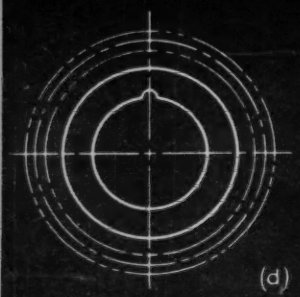
AMERICAN STOCK GEAR DIVISION
PERFECTION GEAR COMPANY, HARVEY, ILLINOIS



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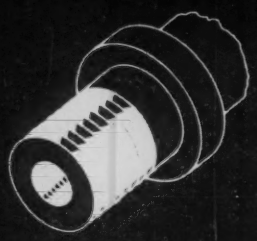

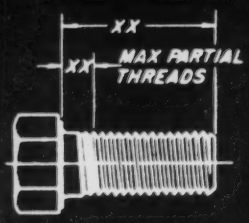

SUGGESTED SIZE OF CURL FOR INSIDE OR OUTSIDE DESIGNS

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Whether you need information on the fundamental principles of dimensioning, layout practices, pictorial sketching, projection, control and form tolerancing of geometric surfaces, the preparation of diagrams, or the special requirements for metal stampings, plastics, etc., you will find it in these twelve sections of the

AMERICAN DRAFTING STANDARDS MANUAL

SIZE AND FORMAT (Section 1), Y14.1 — 1957. $1.00

Deals with sheet sizes; the basic format; location of title and revision blocks, positioning of lists of material and drawing numbers, and print fold. Illustrated.

LINE CONVENTIONS, SECTIONING AND LETTERING (Section 2), Y14.2 — 1957. $1.50

Scope: Line symbols; visible and hidden lines; section, center and dimension lines; extension lines and leaders; cutting plane lines; break and phantom lines; section lining on detail and on assembly drawings; direction and spacing of general purpose section lines; the cutting plane; full and half sections; location of sectional views; lines behind the cutting plane; broken-out, revolved, removed, offset, auxiliary, and thin sections; sections through webs, shafts, bolts, pins; foreshortened projections and rotated features; intersections in section; sizes of lettering for different purposes.

PROJECTIONS (Section 3), Y14.3 — 1957. $1.50

Covering arrangement of views for multiple view orthographic projections, this section describes and illustrates practices in the choice and arrangement of the views; use of partial, alternate, removed and revolved views; auxiliary views; conventional breaks; and rounded and filleted intersections; developed views; descriptive geometry applications.

PICTORIAL DRAWING (Section 4), Y14.4 — 1957. $1.50

Here the various kinds of pictorial drawings are defined and the correct method of using them described. Axonometric, oblique, and perspective drawings are fully considered, and a number of examples presented showing the variety of positions in which the axes may be placed. Suggestions are given on the proper pictorial arrangement of sectional views, thread representation, the use of break lines, indicating fillets and rounds, unidirectional and pictorial plane dimensioning, shading, and phantom drawing.

DIMENSIONING AND NOTES (Section 5), Y14.5 — 1957. $2.00

Deals with the rules, principles, and methods used for specifying design requirements on drawings; illustrates how dimensions and notes should be used; and includes dimensioning practices for the control and form tolerancing of geometric surfaces.

SCREW THREADS (Section 6), Y14.6 — 1957. $1.50

Presents the approved methods of placing screw thread data on drawings and a considerable amount of information on thread tolerances useful to draftsmen. Typical drawing notes are shown along with specific practices for dimensioning.

GEARS, SPLINES, AND SERRATIONS (Section 7), Y14.7 — 1958. $1.50

Although this section is not intended to be a text book on gear design, it does give reasons for the methods shown and specified, so that the user will have some basic understanding of the need for more detailed gear-tooth dimensioning and specifications. Also included are the delineation and specification of Splines and Serrations.

FORGINGS (Section 9), Y14.9 — 1958. $1.50

In this standard is the needed information on preparing drawings for forgings, arranged in logical sequence and in usable form. The coverage includes properties of forgings, limitations, materials for forgings, production methods, parting line, forging plane, draft, fillets and corners, radii, web thickness, tolerances, forging drawings, including the parting line, unequal die depths, ribs, end draft for cylinders, intersections, and dimensioning.

METAL STAMPINGS (Section 10), Y14.10 — 1959. $1.50

Sets forth practices used by small parts manufacturers in the production of metal stampings as produced on standard types of punch presses. Here too, will be found help in laying out and delineating a product which will be subjected to metal stamping processes. References to methods of fabrication, die clearances, etc., are also included.

PLASTICS (Section 11), Y14.11 — 1958. $1.50

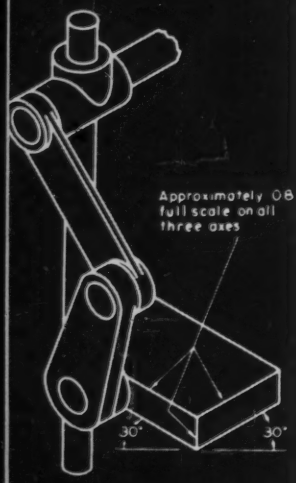
This section discusses basic preferred design and drafting practices specifically related to parts formed of plastic material. To assist the designer and draftsman in the delineation of plastic part drawings, a brief discussion of materials, manufacturing processes, and operations is included along with design and drawing hints for parts which are formed of the molding and laminating type plastics. Tolerance is also discussed from a general standpoint.

ELECTRICAL DIAGRAMS FOR ELECTRONICS AND COMMUNICATIONS (Section 15), Y14.15 — 1960. $1.50

Besides definitions and general information on electrical diagrams, this standard contains specific help and guidance in the preparation of single-line diagrams and schematic diagrams used by the electronics and communications industries. Items covered include layout; ground symbols; terminals; indication of parts; reference designations; methods of expressing resistance, capacitance, and inductance values; functional identification of parts; test points; additional circuit information; and single-line diagrams for microwave circuits.

FLUID POWER DIAGRAMS (Section 17), Y14.17 — 1959. $1.50

This section not only establishes drafting practice for fluid power diagrams but also furnishes, for the first time, a comprehensive text and reference work on the subject. It explains in detail the data and notes which should accompany symbols and lines to make the diagram meet specific requirements. Types covered are: Pictorial diagram which may be used for quotation and piping the installation; cutaway diagram which is most often used for instruction purposes; graphical diagram which may be used for quotation, piping the installation, and for analyzing circuit operation; and a combination diagram which is used to emphasize purpose and operation of a portion of a system. Several examples of complete diagrams of each of these four types are included, also symbol data form ASA Y32.10.



Supplementing the recommendations are numerous sketches along with diagrams illustrating good drafting practices.

Price of these twelve sections and binder: $19.00 20% discount to ASME members.

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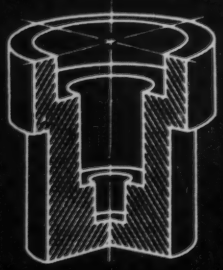

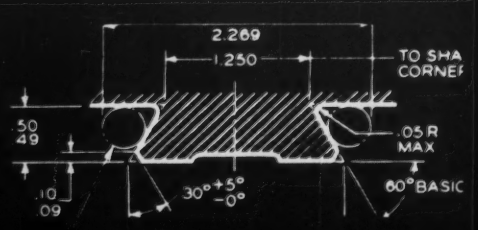

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Centrifugal Pumps

Where relatively small quantities—up to 115 gpm—of corrosive chemicals or slurries, thick or abrasive, must be handled for heads up to 150 ft, two sizes of a new line of single-stage side-suction open-impeller pumps are now available from Goulds Pumps, Inc.

Designated as Model 3199, the pumps have 1-in. flanged discharge and 1 and $1^1/_2$-in. flanged suction connections. Flanges are flat face 150-lb standard. Standard assembly provides top vertical discharge but horizontal top or bottom-discharge position is also available. Frame has wide openings giving ready access to gland and stuffing box and is provided with cooling chamber to isolate bearings and prevent heat transfer to the bearings. Grease lubrication of the ball bearings is standard but oil lubrication can be furnished on order.

Impellers are statically and hydraulically balanced and are provided with ejector vanes on the back wall to prevent entrance of solid material and to reduce stuffing-box pressure. The stuffing box has five rings of dieformed packing and lantern-type liquid-seal ring. Tapped in-and-out openings to seal ring allow use of clear-liquid seal, clear-liquid flush, or grease seal to solve individual packing problems when pumping slurries. Mechanical seals can be used without making any alterations in the stuffing box.

Pumps are available in bronze-fitted, all-iron, all-bronze, Type 316 stainless steel, and Gould-Alloy 20. —K–34

Step-Heater Mats

Unique electric concrete step-heater mats, designed to clear snow and ice from concrete steps, have been introduced by Edwin L. Wiegand Co.

When snowfall or freezing begins, the heaters will prevent any accumulation and keep concrete steps clear and safe. No shoveling, salt, or cinders are necessary for slip-proofing step surfaces.

The heaters are Thermwire heating cable interwoven with light weight galvanized mesh. They are offered in 2-step and 3-step units, heating a section 8 in. wide by 36 in. long on each step. Any combination may be used to match the number of steps requiring protection.

Furthermore, they have a rating of 42 watts per sq ft, which will clear snow and ice in almost any climate in the country. Each heater unit contains a 10-ft lead wire and a 10-ft ground wire. All cable sections are sheathed in polyvinyl with a nylon coating for extra durability. The heater units positioned on top of the freshly poured first layer of concrete, then covered with the 1 to $1^1/_2$-in. top layer of concrete.

The heaters are connected to an inside wall switch so that a mere flick of the switch clears steps of any dangerous snow and ice. —K–35

Filter Regulator

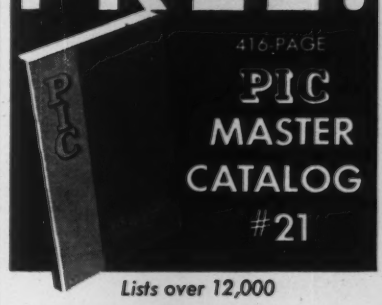
A rugged, lightweight, and economical new filter regulator, applicable wherever a controlled supply of clean air or gas is needed, has been introduced by Rockwell Mfg. Co.

The 080 filter regulator, counterpart of Rockwell's standard 080 instrument regulator, has a wide range of applications in commercial and industrial control systems. It is especially suited for single-unit hookups and production equipment, paint-spray units, air chucks, gas drives, instruments, and air cylinders.

Constructed of pressure-die-cast aluminum, the 080 filter regulator has a maximum inlet pressure of 250 psi and outlet pressure ranges of 0 to 5, 5 to 35, and 35 to 100 psi. Optional construction includes a handwheel adjustment and a $^1/_4$-in. side outlet tap for pressure-gage mounting.

General construction and performance is the same as the instrument regulator with the exception of the body, which has been modified with a filter bowl. This bowl contains a replaceable filter cartridge made of graded-density wool fiber, and a $^1/_8$-in. drain valve located at the bottom of the filter bowl. It is available without internal relief valves. —K–36

FREE!



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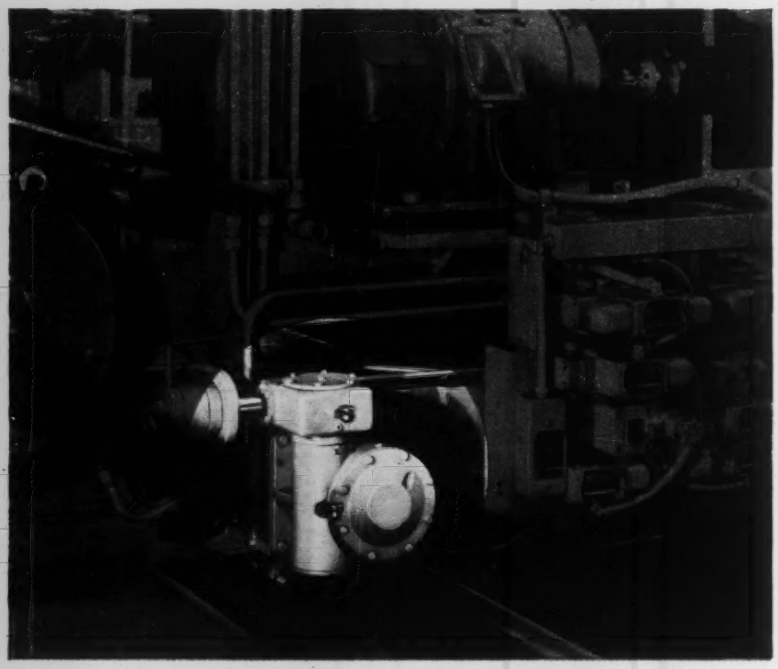

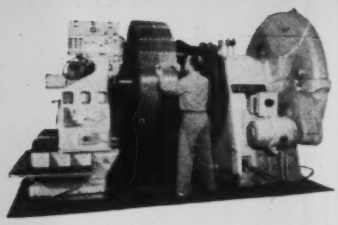

Farrel Model 10-T can cut gears having a max. pitch dia. of 120" with a 24" face. The generating feed mechanism is controlled by a hydraulic drive through a Winsmith Model 7 CVD Double Reduction Worm Gear Speed Reducer—ratio 120:1—providing maximum flexibility and a wide feed range.

Farrel Gear Generators—manufactured by Farrel-Birmingham—are machines of unusual accuracy and versatility. They are used for mass production, general jobbing and tool room work. Their speed, precision and convenience of operation increase output and decrease costs of generating gears of all types.

Farrel-Birmingham selected Winsmith Worm Gear Speed Reducers because of their compactness, precise heavy duty construction, their ease of maintenance and parts availability. These add up to maximum service—minimum maintenance and downtime.

WINSMITH SPEED REDUCERS

WRITE TODAY for complete selection information and engineering data on the hundreds of Winsmith types and sizes. For every application—from 1/100 to 85 hp., in ratios from 1.1:1 to 50,000:1—you'll find it pays to standardize on Winsmith.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Centrifugal-Cast Tubing

Thanks to a new centrifugal-casting process developed by the Special Products Div., American Cast Iron Pipe Co., engineers can specify the exact OD and wall thickness of tubing to meet specific design requirements for high-pressure, high-temperature piping and for tubular mechanical components such as rolls and hydraulic cylinders. The need for special dies or patterns is eliminated and engineers are no longer limited to commercially available standard pipe sizes.

Called the Acipco Ceram-Spun process, the great improvement in size range and size selectivity has been made possible by using ceramic-lined metal flasks for casting the molten steel or other metal compositions. Older methods of centrifugal casting use either metal molds with a sprayed refractory facing or sand molds rammed around a cylindrical pattern inside a metal flask. The ceramic lining is produced centrifugally in much the same manner as the tubes themselves, by pouring a ceramic slurry into a rapidly spinning metal flask, followed by draining the water, and then baking.

By simply varying the thickness of the ceramic lining, a wide range of ODs can be made in a metal flask of a given size. With a relatively small number of flask sizes, steel tubes with ODs in innumerable variations from 2.25 to 50.00 in. can be produced. Wall thicknesses range from 0.25 to 8.00 in. The standard length is 20 ft, but shorter lengths can be produced at slightly additional cost by use of mold stops.

Other advantages of the Acipco Ceram-Spun process include flexibility in metal composition, high casting yields, nondirectional tensile properties, excellent weldability and machinability, and a high degree of mechanical integrity.

Tubes are produced in carbon steel, low-alloy steel, heat-resistant and corrosion-resistant stainless steels, and both plain and alloy cast iron. Lenths longer than 20 ft can be produced in most grades of steel by submerged-arc welding.

Applications include normal and high-temperature, high-pressure piping, hydraulic cylinders and piston rods, textile rolls, paper rolls, roll-out table rollers, and unfired pressure vessels. Tubes can be furnished as cast, rough machined, or finish machined. In addition, outside surfaces can be superfinished to 1 to 2-microin. finish, and inside surfaces can be honed to 8 to 16 microin. finish. **—K-37**

Read the Classified Ads appearing in the "Opportunities" Section each month

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8, 9	23	33	140	153	165	182
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K-3	K-13	K-23	K-33	K-43	K-53	K-63	K-73
K-4	K-14	K-24	K-34	K-44	K-54	K-64	K-74
K-5	K-15	K-25	K-35	K-45	K-55	K-65	K-75
K-6	K-16	K-26	K-36	K-46	K-56	K-66	K-76
K-7	K-17	K-27	K-37	K-47	K-57	K-67	K-77
K-8	K-18	K-28	K-38	K-48	K-58	K-68	
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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
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Coating for Aluminum Siding

Pittsburgh Plate Glass Co. has developed a one-coat baked enamel based on its unique series of Duracron thermosetting acrylic resins and possessing superior chemical properties that afford longer life than any other single-coat organic baked film designed for application to aluminum siding.

According to the company, it embodies more outstanding properties than other known organic-type finishes to offer protection against chipping, cracking, flaking, peeling, or blistering and insure a maintenance-free, durable finish on aluminum siding.

Extensive field tests show that the coating will endure for years in corrosive salt air and industrial fumes, thereby offering substantial savings on paint maintenance. Under normal conditions the hard, smooth aluminum-siding finish, which has remarkable resistance to dirt pickup, can be maintained simply by hosing down the surface periodically.

Adhesion, flexibility, chemical resistance, durability, color retention, ease and uniformity of application are said to be superior to those for other organic coatings. Duracron thermosetting acrylic-resin coatings become extremely hard, insoluble, and infusible after baking.

Cost is comparable to that of other coatings. Factory finishing of aluminum siding with Duracron by the roller-coat method is ideally suitable and most practical. Spray-finishing methods can also be used. —K-38

Power Hammer

An electric power hammer made by Ingersoll-Rand Co. features greater durability, less maintenance, and faster operation than its predecessor. The H541U hammer delivers about 2500 blows per min for roughing and breaking up concrete; chipping scale, rust, or weld spatter; driving self-drilling anchors; pointing up stonework; peening rivets, and similar jobs.

The piston rod is designed for greater strength and greater contact with a nylon buffer for long service life. A sturdy spring increases the piston's impact. Use of a spring eliminates maintenance problems caused by leaky air cushions or broken rubber thongs. The connecting rod is forged aluminum, and the crosshead stem is chromeplated.

The H541U is light in weight and ideal for overhead jobs. The hammer weighs only $11^{5}/_{8}$ lb without the cable, and $12^{3}/_{4}$ lb with the cable. Designed for compactness, the H541U is $15^{3}/_{4}$ in. long, $8^{13}/_{16}$ in high, with a $^{7}/_{8}$-in. side-to-center distance at the barrel. It accommodates drills up to $1^{1}/_{8}$ in.-dia. hole size.

The new hammer's motor operates on standard 115-volt a-c or d-c current with a motor rating of 5.0 amp. A 230-volt motor with a 2.5-amp rating can be furnished. —K-39

from LITTLE LIFTS...

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Warehouse Expansion

Norma-Hoffmann Bearings Corp. has completed the second expansion in less than a year at its Philadelphia and Atlanta warehouses. Capacity at the Philadelphia warehouse has been increased by 40 per cent and at Atlanta, a 50 per cent increase has been completed. The new moves are aimed at increasing the speed and service to a growing number of distributors and industrial users in the middle Atlantic states and in the southeast.

The company maintains 16 warehouses across the country and nearly 500 distributors of precision ball, roller, and thrust bearings.

Heat-Exchanger Plant Acquired

Yuba Consolidated Industries, Inc., of San Francisco has acquired Coynco Products, Inc., of Tulsa, Okla. The operation will be known as the Yuba-Tulsa Corp., a subsidiary of Yuba Consolidated Industries, Inc.

The Tulsa plant will be expanded and developed into a major manufacturing center for Yuba's shell-and-tube and air-cooled heat exchangers, used by the petroleum, petrochemical, and chemical industries. Volume of the plant will be increased three to four times, and area will be increased some 30 per cent by the addition of new bays. Two new railroad sidings will be added and new craneways constructed. The plant's production capabilities will be further diversified. Employment is expected to be doubled.

LATEST CATALOGS

Packaged Turbo Pump

A technical bulletin is available with all details of a new IND pump, made by Coffin Turbo Pump which has turbine, pump, and controls in one integral, matched unit. All parts are 100 per cent interchangeable. It is a highspeed, single-stage, diffuser type of extremely simple construction. Positive lubrication is assured by oil splash rings incorporating an oil-dam system. Capacity is 180 gpm and discharge pressures extend to 350 psi. **—K-40**

Universal Joints

The Mechanics Universal Joint Div. of Borg-Warner Corp. has just published a comprehensive catalog, No. J-1960-1, of universal joints for the agricultural and implement fields.

General universal-joint engineering data, agricultural-equipment status for power take offs, complete joint specifications, servicing instructions and ordering information are included. **—K-41**

BUSINESS NOTES

New Thermostat Plant

The Robertshaw-Fulton Controls Co. recently opened its new $4-million 360,000-sq ft Robertshaw Thermostat Div. manufacturing plant near Youngwood, Pa.

European License Agreement

Link-Belt Speeder power shovels and cranes will soon be manufactured in Italy for sale there and in other European Common Market countries, the Link-Belt Co. has announced.

The Italian firm of Orenstein & Koppel of Milan, manufacturers of a wide range of excavating and construction equipment, has been licensed to manufacture and sell Link-Belt shovel cranes in Italy, and to sell them in other Common Market countries through Link-Belt, S.A., of Geneva, Switzerland.

KEEP INFORMED

BUSINESS NOTES
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Pneumatic Clutch and Brake

The Warco Pneumatic Clutch and Brake is described in Federal Machine and Welder Co. Bulletin No. 52100. It can be used as replacement equipment on all makes of presses. —K–42

Algebraic Compiler Manual

A manual available from Bendix Computer Div., makes it possible for engineers to program the general-purpose G-15 ALGO compiler in universal mathematical language.

The 32-page manual describes ALGOL—the international algebraic language—and sets forth the procedures for the representation of numerical data and control statements. Step-by-step examples illustrate the principles and operational characteristics of the compiler. Also included is a complete typical ALGO program. —K–43

Circular Chain

A brochure describing Acme's circular chain has just been issued by the Acme Chain Corp. This roller chain is designed to operate on curves. It's most common use is to act as a transfer medium from one straight-line conveyer to another. —K–44

Electromanometer

The Transducer Div. of Consolidated Electrodynamics Corp. is offering Bulletin 1156 describing their new Miniature Electromanometer System, a precision measuring device that provides secondary-pressure standard accuracies for laboratory, field, or industrial applications. A block diagram and specifications of the system are contained. —K–45

Centrifugal Pumps

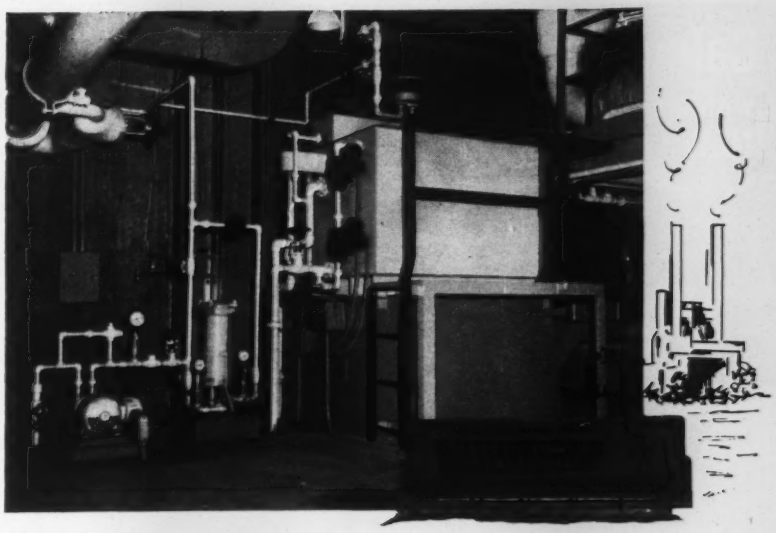
A new technical data sheet describes the line of vertical single-stage split-case centrifugal pumps recently announced by Aurora Pump Div. of New York Air Brake Co. Identified as Type OJV and OMV, these new vertical base-mounted pumps retain the characteristics and performance features of the Type OJ and OMB horizontal split-case line. They are for applications where extreme compactness is of prime importance, handling high capacities at medium to high heads and continuous operation.

Capacities range to 6000 gpm and heads to 380 ft. —K–46

Electrical Switches

Electrical switches for consumer, industrial, and military products are shown and described in McGill Switches Catalog No. 60, released by the Electrical Div. of McGill Mfg. Co.

Toggle switches, rocker-type switches, momentary-contact switches, push-button switches, and special switches engineered for specific applications are included in the line. —K–47



NUGENT Oiling and Filtering System

Protects 150,000 KW Steam Turbine

The Nugent Oiling and Filtering System shown above serves a 150,000 KW Westinghouse Steam Turbine. The installation is located at the Riverbank Generating Station of Oklahoma Gas and Electric Company, Oklahoma City.

Among the pieces of equipment comprising this Nugent system are:

- Fig. A736-20S turbine oil gravity filter.
- Fig. 687-3 sight overflow.
- Fig. 1020TB-3 motor driven oil circulating pump. (10 GPM, ¾ HP)
- Fig. 1555-4S oil polishing filter. (pressure)
- Fig. 1142 two-compartment oil storage tank. (Not shown.) Capacity dirty oil compartment—5000 gals. Capacity clean oil compartment—750 gals.

Whether you require a single component or an entire oiling and filtering system, see Nugent first. You *can* prolong the service life of valuable equipment through Nugent's finer products . . . better methods.

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OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

Precision Spiroid Gears

A 24-page catalog, No. 22, covers the new line of precision spiroid gears made by PIC Design Corp. Complete specifications, detailed drawings and prices on these unique-design, high-performance worms and gears are included. —K–48

Tubing

An eight-page brochure published by the Tubular Products Div. of the Babcock & Wilcox Co., designated T-459, covers electric-resistance-welded carbon-steel mechanical tubing, and B&W's unique Lectrosonic cylinder tubing and Lectrosonic JIC hydraulic line tubing. Continuous ultrasonic inspection of the weld zone assures ultratight standards of conformity. —K–49

Tooling Balls

Applications and specifications of hardened stainless-steel tooling balls are covered in a six-page bulletin announced by Industrial Tectonics, Inc. These products consist of a precision ball and shank, and are used in making and checking jigs, fixtures, and machine setups.

The bulletin shows how the center of the ball serves as a reference point in locating holes and surfaces at compound angles or in two or more planes. Photos and descriptions of shop applications are included, together with details and specifications on fixture balls (with plain shank) and checking balls (with reference shoulder) of ¼ to 1-in. ball diameter. —K–50

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one-half actual size

Functional as it is, a 10-inch slide rule just wasn't meant for stuffing in the pocket of a business suit. Just as the 10-inch is best for desk-duty, the 5-inch JET-LOG Jr. is *ideal* for the man on the go. Has the same famed Decitrig Scale System as its "big brothers"; the DECITRIG® and JET-LOG Slide Rules. Made of durable IVORITE® with top grain leather case, clip, *and* . . .

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Rotating Transmission

Control flexibility, high torque capacity, and compact size are significant features of a new Roto-mission rotating transmission described in an Airborne Accessories Corp. bulletin.

Available in capacities from fractional through 60 hp, Roto-mission is a differential planetary-gear transmission providing up to six times more torque capacity than any other comparable unit and a high degree of control flexibility for a wide range of applications.

Bulletin sections are included on various control options and accessories and on ways of obtaining dual-speed operation. A final section lists typical applications and illustrates the diversity of uses in various industries. **—K-51**

Switch

A two-page data sheet, No. 179, describes an adjustable differential travel switch developed by Micro Switch Div. of Minneapolis-Honeywell Regulator Co. The switch, No. 10BS210, has a 0.0025-in. minimum differential travel which is adjustable to 0.007 in.

The 10BS210 is ideal as the cycle-adjusting element of such precision devices as pressure controls and blower-fan controls. A dial wheel on the switch is turned to vary the contact-break distance. This, in turn, changes the differential travel and affects other characteristics proportionately. **—K-52**

Flexible-Cushion Couplings

Two new types of Dodge Para-flex flexible-cushion couplings, one for high-speed, high-torque applications and another for attachment to flywheels of internal-combustion engines, are described in a 20-page bulletin issued by Dodge Mfg. Corp. These are offered in sizes to deliver up to 47 hp per 100 rpm, with bushings to fit shafts up to 4 in. in dia. Hubs can be ordered bored to size to fit larger shafts, up to 6 in. **—K-53**

Electric Heating

"Fresh-Air Electric Heating By Lennox" is the title of a 40-page brochure available from Lennox Industries Inc. The brochure presents the various methods of space heating by electricity and demonstrates the desirability of ducted systems which permit the addition of such accessories as humidifiers, dehumidifiers, electrostatic air filters, activated-charcoal purifiers, sterilizing lamps, and ionization machines.

System design receives a thorough treatment including a description of the various supply outlets and how they should be applied. Required air-circulation volume, where the heat is best applied, thermostat control and the matter of zoning also are dealt with in detail. **—K-54**

KEEP INFORMED

BUSINESS NOTES
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Visual Control

"Graphic Visual Control," a 24-page book, describes the Boardmaster system of control for inventory, parts assembly, loading, or nearly any other operation which can be charted or graphed.

Postage-stamp-size snap-in cards, in a variety of colors, are the basic item in this control device made by Graphic Systems. Starting with a plain aluminum board, the assembly begins by first posting any of a large number of stock printed headings. This is done simply by anchoring their four corners in small grooves. Plain cards for data entries are of top-quality index stock and come in strips for easy typing. They may be interchanged up to 50 or 60 times in normal use. —K-55

Speed Reducer

"Parallel-Shaft Speed Reducers," Book 2719, describes the Link-Belt Co. redesigned and expanded line of "balanced-design" parallel-shaft reducers in 57 sizes, including 23 new ones. Single, double, and triple-reduction units are available in capacities up to 2800 hp at high or low-output speeds, and ratios up to 292:1.

Full information is given for selecting the correct drive for every application, and 16 pages of rating tables contain thermal and mechanical-horsepower ratings for each input and output speed. Load classes are shown for almost 250 driven machines. Overhung loads, extended shafts and outboard bearings, dimensions and actual ratios are included in additional tables. —K-56

Process Equipment

A 16-page catalog on process equipment has been published by Patterson Foundry & Machine Co. Included are technical data on processing systems and vessels, conical blenders and vacuum dryers, grinding mills, the Mil-Reactor and a variety of agitation and mixing equipment. A section also is devoted to ceramics—for grinding media and linings, for catalyst suspension, and for corrosion and abrasion-resistant applications. —K-57

Fuse Panels, Service-Entrance Equipment, Switches

A 20-page product guide issued by American Electric Switch Div., Clark Controller Co., gives installation and application data on a complete line of: Fuse panels, service-entrance equipment, general-purpose switches, general-purpose toggle switches, safety switches, industrial switches, and double-throw switches. Cabinet dimensions of all units are also included.

An engineering data section gives: (*a*) Allowable current-carrying capacities of insulated copper conductors in amperes, (*b*) number of conductors in conduit or tubing, (*c*) load and circuit information for residential electrical systems. —K-58

Don't take chances on couplings

CHECK PUBLISHED MISALIGNMENT RATINGS BEFORE YOU BUY

Since misalignment is the basic problem that shaft couplings are designed to solve you'll find a published conservative misalignment rating (along with load capacity rating) for every Fast's Coupling. Compare it with the misalignment rating of any other coupling you are considering. One further advantage of Fast's Couplings' misalignment ratings: You save money on installation because, knowing the ratings, you don't have to line up driving and driven elements with pinpoint accuracy. It's one more important reason why Fast's Couplings are the choice of more equipment manufacturers than any other gear-type coupling. KOPPERS COMPANY, INC., 512 Scott Street, Baltimore 3, Md.

KOPPERS

FAST'S COUPLINGS

Engineered Products Sold with Service

Die-Casting Machines

The complete line of Cleveland Automatic Machine Co. high-pressure hydraulic die-casting machines, in 100, 250, 400, 650, 850, 1000, and 2000-ton models is described in a 12-page bulletin. Details are included on such advanced optional features as machine automation and vacuum die casting. —K-59

Corrosion-Resistant Steel Pipe and Tubing

Ways in which Niphos nickel-alloy-bonded steel pipe and tubing are being used to counter corrosion and iron contamination are described in a brochure issued by the "Nickel-Over-Steel" Div. of M. L. Sheldon & Co.

The applications for which the patented coated-steel product is recommended have been developed through in-service performance of production quantities during the past three years. —K-60

Drive Control

Data for control of marine cargo handling, offering custom-engineered adjustable a-c speed drive control for specific applications is given in eight-page General Electric Co. Bulletin GEA-7202. Design flexibility permits precise speed regulation of gantry and rotating cranes, cargo winches, windlasses, and capstans with counter-torque and regenerative braking. Stepless static control is provided over the entire speed range from a single master switch with no d-c conversion equipment, and static reversing control is obtained with saturable reactors and trans formers. —K-61

Power Springs

A 12-page booklet issued by Sandvik Steel, Inc., describes the company's line of Sandvik flat-spiral power springs including two variations of a new spring design. Four types—spiral, crosscurved, stainless, and integral band with and without bridle—are described.

The booklet provides reference data on spring nomenclature, various types of ends and centers and lists data required when ordering springs. It also provides background information on Sandvik and its production and quality control facilities. —K-62

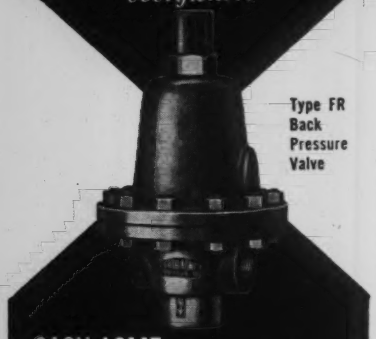
Self-Cleaning Filters

The Cuno Engineering Corp. has released a 16-page catalog, designated No. 51-100, on its line of Auto-Klean and Super Auto-Klean Filters. These all-metal, edge-type units are self-cleaning and do not require cartridge replacement. A filter-selector chart and a complete set of flow tables are included. —K-63

Index Tables

Cam indexing for light loads and moderate speeds is provided with accuracy and smoothness by the Camo light-duty index tables described in a four-page data sheet issued by Ferguson Machine Corp. Roller-gear-drive indexing is claimed to provide inherent precision and smooth operation while the integral reducer simplifies maintenance and improves performance. —K-64

CASH-ACME . . . meeting pressure control needs for product design engineers everywhere



CASH-ACME SPECIAL BY-PASS VALVE HELPS AIR FORCE LICK ICE PROBLEM IN ARCTIC

The greatest potential "saboteur" at Strategic Air Force Command bases in the Arctic is ICE. That's why mobile de-icers are as highly prized as radar.

In perfecting modern de-icing equipment, air force designers received an invaluable assist from Cash-Acme engineers. Since ordinary valves and liquids are completely inoperative at 65° below zero, new methods were urgently needed. With the help of Cash-Acme Back Pressure Valve (Type FR) specially modified for this extremely rigorous job—a unique sprayer was developed for discharging ethylene glycol.

Using high pressure spray nozzles to thaw out iced-up areas, crewmen keep jet bombers and interceptors ready for instant take-off.

TYPE FR BACK PRESSURE VALVE
Ready for tough, exacting jobs anywhere. Automatically controls desired maximum pressure by maintaining a determined inlet pressure at valve and relieving into a low pressure line. Readily usable for all liquids and gases. Slight modifications make it useful as a differential pressure regulator. For Answers to Pressure Control Problems in Your Product.

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CASH ACME

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NEW EQUIPMENT
BUSINESS NOTES
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Fork-Lift Trucks

A brochure describing five heavy-duty fork-lift trucks designed to handle van-sized shipping containers is available from Industrial Truck Div., Clark Equipment Co.

The gas-powered, pneumatic-tire Van-loader trucks range in capacity from 14,500 to 45,000 lb at 48-in. load centers. They can handle all shipping containers presently in use, including 10-ft units used for city delivery and 40-ft containers for long-haul and marine shipping. **—K-65**

High-Speed Indexing

Engineering data and methods of calculating load requirements for roller-gear drive precision indexing mechanisms, Intermittor index tables, rotary and in-line transfer machines, and allied power-transmission components are contained in 44-page Catalog No. 160A issued by Ferguson Machine Corp. Load ratings and complete dimensions are given for many standard units, some of which are designated as stock items. **—K-66**

Electric Motor Controls

Catalog No. 5900 issued by Furnas Electric Co. is a 72-page list of a wide variety of motor controls—magnetic starters, manual starters, drum controllers, pressure switches, push-button devices, and many others. Auxiliary devices and replacement parts are also listed. **—K-67**

Syncro-Range-Drives

The Louis Allis Co., has announced the introduction of Bulletin 111 Syncro-Range-Drives, ranging in sizes 2 to 15 hp, and providing adjustable speed of synchronous induction motors running in exact synchronism over a wide range of speed.

The drive is an integrated system consisting of an adjustable-frequency power supply, one or more Syncro-Spede drive motors, and a control panel. Adjustable-frequency power is supplied from an a-c alternator driven by a constant-speed squirrel-cage induction motor which provides infinitely adjustable speed through the mechanical interaction of adjustable disks and a ribbed belt. By adjusting the power-supply output, the drive motors can be varied in speed over a wide range, maintaining exact synchronism of all motors at any fixed speed and also while increasing or decreasing speed. Control panel includes alternator field supply and all necessary controls for proper operation of the drive.

The Syncro-Range-Drive is designed for operation of multiunit conveyers; textile or paper printing or finishing, synthetic-fiber spinning, drawing or twisting; metal run-out tables; and many other similar continuous-process machines which require the application of power at a number of points on the machine. **—K-68**

Laminating Guide

A handy guide to recommended materials, equipment, and production techniques for users of Daponite laminating surfaces—based on Dapon diallyl-phthalate resin—is available from the Dapon Dept. of Food Machinery and Chemical Corp. Daponite laminate imparts durable finishes to high-grade wood veneers and almost any kind of core material with ease and economy.

The 24-page booklet is designed to give furniture and panelboard manufacturers a working knowledge of the requirements for an efficient Daponite laminating operation. **—K-69**

Bolts and Nuts

A new family of superbolts and companion locknuts for applications up to 900 F is covered in two new four-page bulletins published by Standard Pressed Steel Co.

On the 900-F aircraft bolt, the EWB 926, and mating featherweight self-locking nut, the FN 926. Between them, the two new fasteners comprise the first threaded joint of 200,000-psi ultimate tensile strength at 900 F. Room-temperature tensile rating is 260,000 psi min.

Most mechanical properties of the new bolt-nut combination, including tensile, shear, and fatigue strengths, run 15 to 25 per cent higher than those of previous 900-F fastenings.

The EWB 926 bolt bulletin provides tabulated mechanical properties and a plot of tension-tension fatigue performance at various loads—at both room temperature and 900 F.

The FN 926 literature, in addition to dimensional data, includes information on torquing properties and on the close dimensional control over nut-face angularity. Beneficial effect of the latter on increased fatigue life is also covered. **—K-70**

Power Systems

A complete line of power systems for missile and spacecraft applications is described in 11-page Bulletin A-5239 released by Vickers Inc., Div. of Sperry Rand Corp. The development of complete and separate power-generating systems leading up to the present Vickers line of packaged flight-vehicle power systems is discussed. Four basic types of systems for missile application include the hot-gas motor, hot-gas servo, silver-zinc battery, and the flywheel. Details are also presented on a hydrogen-oxygen system using a positive-displacement engine for spacecraft application.

Of particular interest are curves representing optimum system design over a complete range of power and operating-time regimes. **—K-71**

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Centrifugal Air Compressor

New 20-page Bulletin 175, available from Clark Bros. Co., one of the Dresser Industries, introduces the Isotemp packaged centrifugal air compressor line for air-separation plants and industrial use.

Clark Isotemp centrifugal compressors are built in six frame sizes with horsepowers ranging from 1000 to 8000 bhp and capacities from 5000 to 38,000 cfm. —K–72

Gas Turbine

The 10,500-hp RT-248 gas turbine is the subject of eight-page Bulletin 95 issued by the Cooper-Bessemer Corp. Descriptive, application, engineering, and performance data are given for this stationary unit designed to burn gas or other conventional fuels. Light in weight, flexible in control, and of heavy-duty design, the RT-248 can be used for gas transmission or storage, as a compressor or pump drive in refineries and process plants, for marine or electric-generator drives, or in mobile electric-generating sets. —K–73

Plug Valves

A six-page data sheet describes the advantages of lubricated plug valves made by the Homestead Valve Mfg. Co. Manufacturing methods used to maintain uniform high quality are described, and the production steps are shown graphically. —K–74

Metalworking Machinery

An informative case-study portfolio, No. 1, shows a variety of applications of Fatigue-Proof steel bars in metalworking machinery and equipment parts. Available from La Salle Steel Co., it contains a total of nine individual case studies. The portfolio shows how manufacturers are meeting and solving difficult problems related to parts production.

Each case study describes the machinery, specific part involved, and the material it replaced. Included is information concerning the elimination of heat treating, straightening, grinding, and distortion, plus improvements in machinability, wear, and cost. —K–75

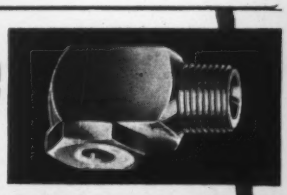
Spring Fasteners

Standard and special spring fasteners in twin-prong or cone-type impressions and push-on types are illustrated in a 14-page catalog issued by George K. Garrett Co., Inc. Data are arranged so that selection of fastener by style, screw, or stud size is easily made. Information concerning tensile and torque and other pertinent design requirements is also provided. —K–76

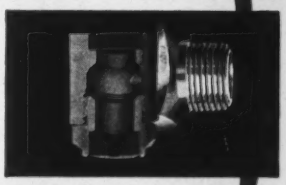
Insoluble-Solids Analyzer

A four-page bulletin has been issued on the Graver Automatic Tape Analyzer by Graver Water Conditioning Co., Div. of Union Tank Car Co. The Bulletin, WC-127, covers all facets of the unit, recently introduced for continuously measuring the level of trace insoluble solids in liquids. It is recommended for monitoring power-plant condensate and makeup and a host of other high-purity testing applications in such fields as chemicals, aviation, foods, and beverages. —K–77

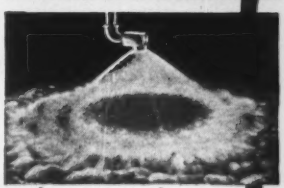
Spray Nozzle types
choice of over 12,000 basic designs



materials
brass, stainless steel, lead, hard rubber, hardened steel, tungsten carbide and many others.



performance
uniform distribution with spray angle, capacity, impact and atomization to your specifications.



to improve every spraying operation

Improve performance, lower spraying costs with Spraying Systems spray nozzles. Prompt delivery. For complete information write for Catalog 24.

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3265 RANDOLPH ST. • BELLWOOD, ILL.
ADVANCED SPRAY NOZZLE DESIGN FOR NEW DIMENSIONS IN CONTROL AND PERFORMANCE

SOUTHWEST
"Monoball"
SELF-ALIGNING BEARINGS

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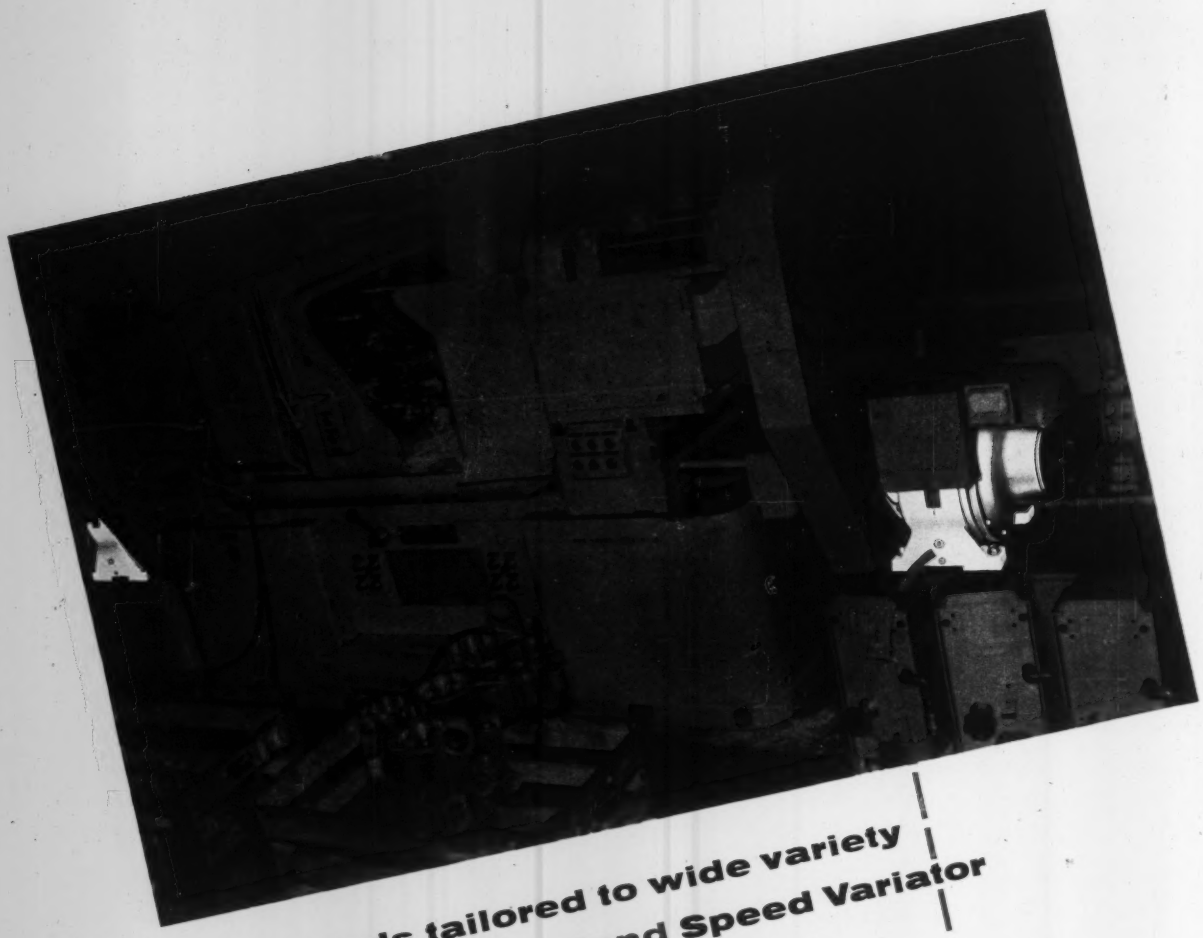
CHARACTERISTICS

	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.
4	"Dyflon"® Plastic Alloy Inserts. CRES Ball and Race. Chrome Alloy Steels.	For types operating under rotational, high radial loads and long cycle life where lubrication is impossible.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Our engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. Write for Engineering Manual No. 551. Address Dept. ME-60

SOUTHWEST PRODUCTS CO.
1705 SO. MOUNTAIN AVE., MONROVIA, CALIFORNIA



Machining speeds tailored to wide variety of metals with Cleveland Speed Variator

In the manufacture of aircraft engine components, Cleveland Speed Variators permit fast, accurate adjustment of machining speeds to the exact rpm required for various metals from magnesium to 38 Rc steel.

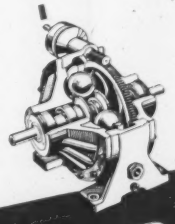
Infinitely variable, the Speed Variator provides continuous speed progressions over its full 9:1 range . . . from ⅓ to 3 times input speed. Manual or automatic remote control instantly and smoothly adjusts output speed. Variator is rugged, compact, quiet running.

For full details—photographs, sectional drawings, rating tables, specifications—write today for Bulletin K-200.

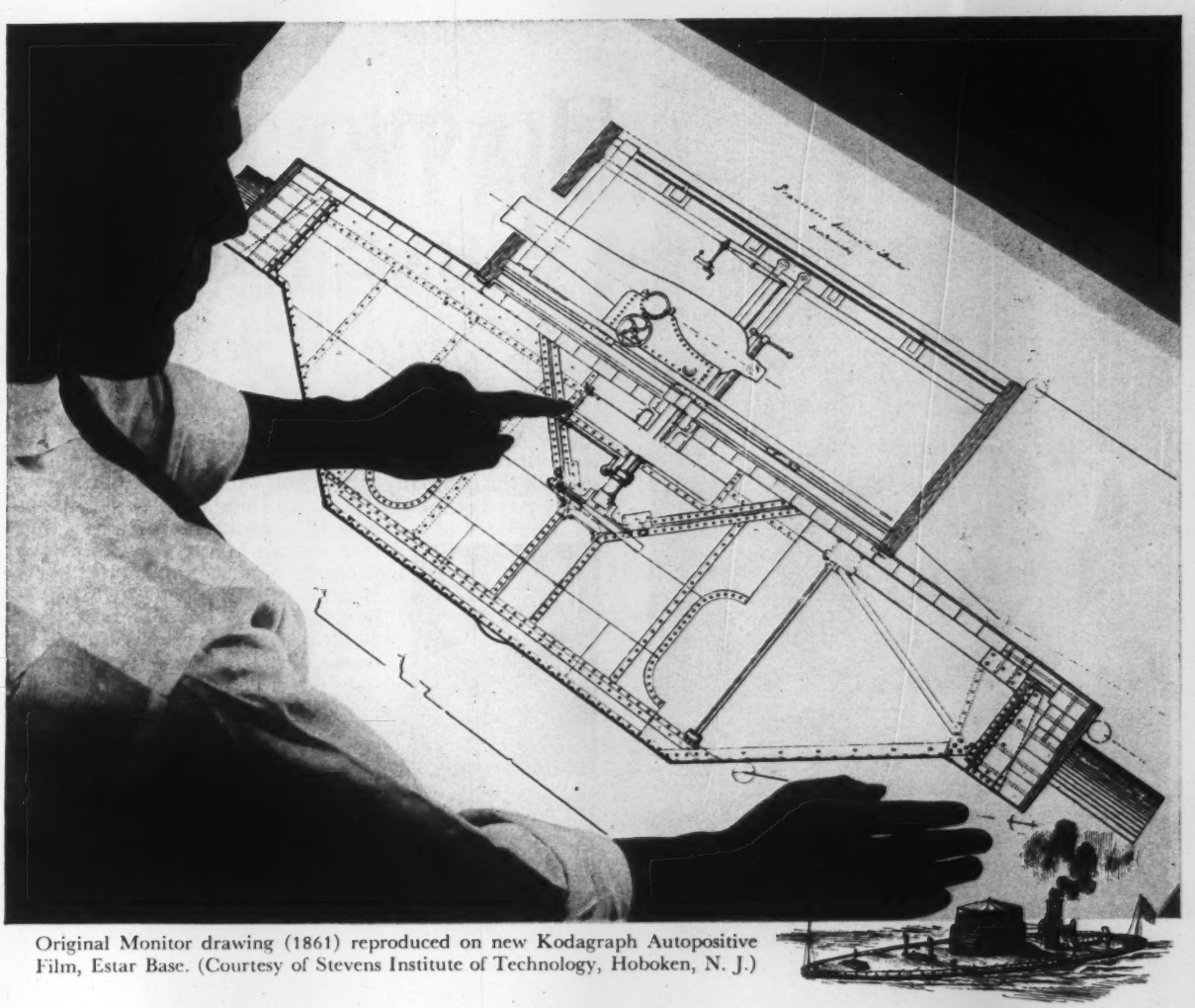
Cleveland Worm & Gear Division
Eaton Manufacturing Company
3264 East 80th Street • Cleveland 4, Ohio

HOW IT WORKS

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, right).



CLEVELAND
PEE VARIATOR



Original Monitor drawing (1861) reproduced on new Kodagraph Autopositive Film, Estar Base. (Courtesy of Stevens Institute of Technology, Hoboken, N. J.)

Made to take the bruises!

New Kodagraph Autopositive Film, Estar Base, gives you intermediates that are as tough as they come and have exceptionally sharp detail.

Here's the ideal choice for general reproduction work and drafting-room use. Same-size, positive intermediates are produced directly without a negative step. And there's the added convenience of being able to expose and process under room light. Excellent results are obtained with either "print-through" or reflex printing, even when reflexing from metal templates.

See this versatile new Kodagraph Film—and the others in the new *Estar Base line:* Kodagraph Contact Film; Kodagraph Projection Film.

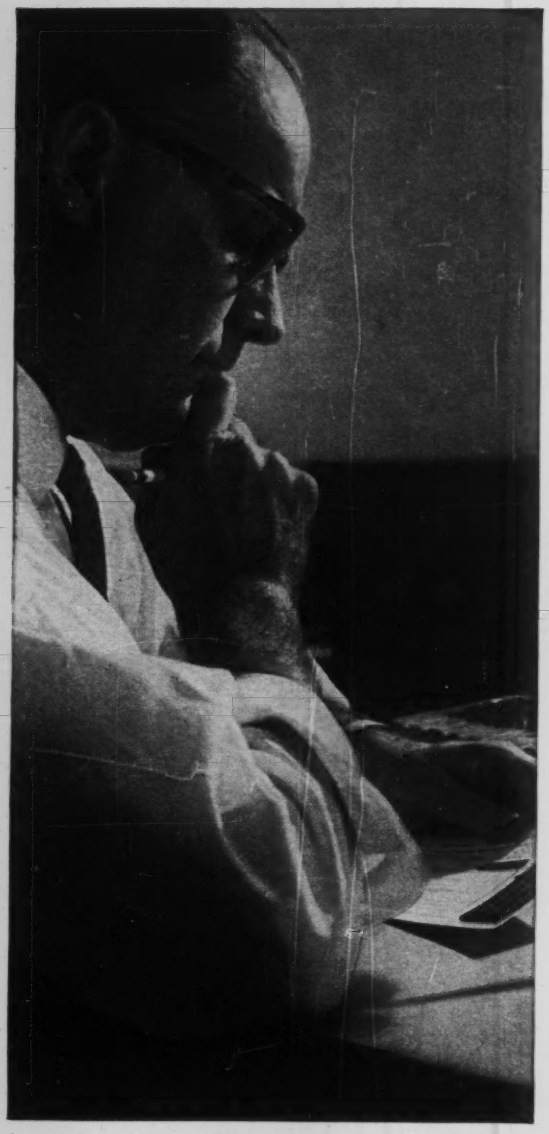
All combine reliable Kodak emulsions on the new Estar Base—highly translucent, durable, and dimensionally stable, with excellent matte surface on both sides for easy drafting. Available in standard drawing sheet sizes and in rolls up to 52 inches wide. Call your local Kodagraph Dealer, or write Eastman Kodak Company, Graphic Reproduction Division, Rochester 4, N. Y.

NEW! **Kodagraph**

REPRODUCTION FILMS

for best line-for-line reproduction

Kodak TRADEMARK



IF YOU DON'T SEE IT, YOU WON'T SPEND IT. Millions of people sign up with the Payroll Savings Plan at work be cause it helps them save money that otherwise might slip through their fingers.

EVERY Savings Bond you own—old or new—earns ½% more than ever before, when held to maturity.

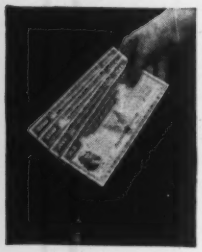
You save more than money with U.S. Savings Bonds

The U.S. Government does not pay for this advertising. The Treasury Department thanks The Advertising Council and this magazine for their patriotic donation.

How to Save Money

in spite of yourself

Many Americans have discovered a way to save money without really changing their spending habits. You simply ask the company where you work to set aside money every payday for U.S. Savings Bonds. The Payroll Savings Plan makes sure that it goes into savings before you can dribble it away. And, if you buy a $25.00 Bond a month (cost $18.75) in 40 months you'll have Bonds worth $1,000 at maturity. You really won't miss it because it adds up to only 63¢ a day.



UNCLE SAM PROTECTS THEM. U.S. Savings Bonds are fully backed by the U.S. Government. They can be cashed like money anytime at any bank. Your money is safe, yet readily available in Bonds.

U.S. Savings Bonds are more than a good way to save

• You can save automatically with the Payroll Savings Plan. • You now earn 3¾% interest to maturity. • You invest without risk under a U.S. Government guarantee. • Your money can't be lost or stolen. • You can get your money, with interest, anytime you want it. • You save more than money—you help your Government pay for peace. • You can buy Bonds where you work or bank.

WILL THEY LIVE IN A PEACEFUL WORLD? Lots of Americans do more than "hope so". They're buying U.S. Savings Bonds to help pay for the strength America needs to help keep the world at peace.

BLH-
EFFICIENT AIR MOVER FOR YOUR
HIGH PRESSURE SYSTEMS

Since the finest air conditioning system available is no better than the fan that powers it, the Buffalo Type BLH Fan merits your most serious consideration.

The BLH is a better fan for your high-pressure system. It's a heavy-duty fan for Classes III and IV service. It offers the highest efficiency over the broadest range. In addition to the quietest, smoothest air ride from inlet to outlet (thanks to curved inlet bell, inlet guide vanes, inlet wheel flange matching the curved inlet bell, backward curve blades and graduated housing) it has the unique Buffalo divergent outlet providing smooth outlet flow and high static regain. For efficiency at high pressures, the BLH is without equal — and for dampered operation, Buffalo Variable Inlet Vanes can be substituted with less than 1 percent reduction in catalog rating; performance that cannot be equalled by conventional variable vane design.

Bulletin F-200 contains performance, construction, capacity and dimensional details. Your copy will be mailed promptly on request.

BUFFALO FORGE COMPANY • BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Buffalo air handling equipment to move, heat, cool, dehumidify and clean air and other gases.

Buffalo Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

Buffalo Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

WHY ARE WE PUTTING AN "ENGINEER" IN MECHANICAL CATALOG?

Beginning with the 1962 Edition of Mechanical Catalog, we'll be calling it the Mechanical *Engineers'* Catalog. The name change is being made to reflect better the use of the Catalog by ASME members, and also to emphasize the improvements that are being made in the Catalog's distribution, directory and format.

You probably know that the Catalog has been an important part of ASME Publications for some time—since 1912, in fact. It was known then as the "Condensed Catalogs of Mechanical Equipment," and the first edition has 480 listings of products by 220 manufacturers. By contrast, the 1961 Edition—just distributed—has more than 50,000 listings, in 6000 product categories, by some 3500 companies.

So, over the years, the Catalog has grown enormously. It is now *the* source of product information for mechanical engineers. For example, we've calculated that each edition of the Catalog is referred to more than 4 million times. About 123,000 engineers use the Catalog to specify equipment and locate suppliers.

We hope that the improvements to be made in the 1962 Edition will make the Mechanical Engineers' Catalog an even better source of information for the mechanical engineering profession. Here they are:

Increased distribution: Each year recently we've had more requests for the Catalog than we've had copies. We hope to have enough next year by raising the printing to 20,000 copies. Circulation will still be restricted to individuals who request the Catalog.

Improved product directory: The requirements of the mechanical engineer change pretty rapidly. Each year, he needs information in different, new, product categories. He wants to know about any new products. We're going to revise the Catalog's Product Directory to make it as up to date as possible. This job is beginning now.

Improved Catalog format: We think the Catalog will be a more useful tool for engineers with a bit of modernization in typography, layout and organization. So we're working on the "eye appeal" of the Catalog, too.

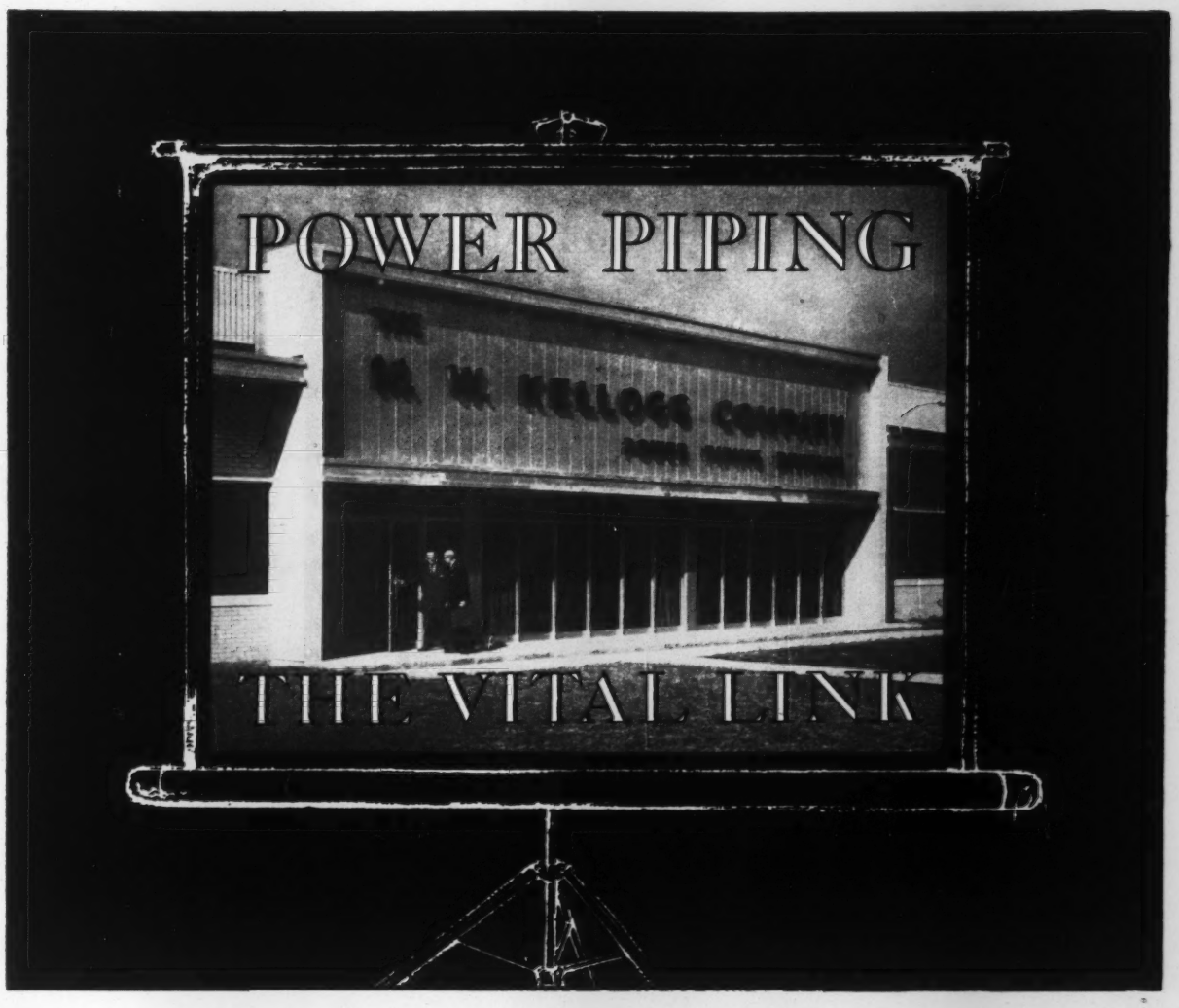
Those are the reasons why we're putting an "engineer" in the Mechanical Catalog. He's there already, when he's looking for product information. We hope to put more of him there, more often, by making the Catalog better and easier to use.

We think you'll like the 1962 Mechanical Engineers' Catalog.

1962 MECHANICAL ENGINEERS' CATALOG

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street **New York 18, N. Y.**



NEW FILM shows how quality power piping helps the nation live better electrically

Just produced by The M. W. Kellogg Company, and available January 1, 1961, this sound-color film on power piping is valuable viewing for utility managements, engineers, and others concerned with the generation of electric power. Explaining in full the subject of power piping, "The Vital Link" also provides an interesting education for users of electricity.

Showing what power piping is, does, and how it is made and erected, and its importance to the utility industry, this new film takes you first into the central station of a large electric utility. It then guides you through Kellogg's new plant at Williamsport, Pennsylvania—the most modern ever designed specifically to manufacture power piping for electric utilities.

In Williamsport, you will follow the many manufacturing steps necessary to assure the highest quality product from the time the raw materials arrive in the plant until finished assemblies are shipped. The final step—field erection in a customer's plant—shows the importance of sustaining quality work to insure efficient production of electricity.

For arrangements to view "The Vital Link" in your own offices or at outside meetings, contact the nearest office of Kellogg's film distributor:

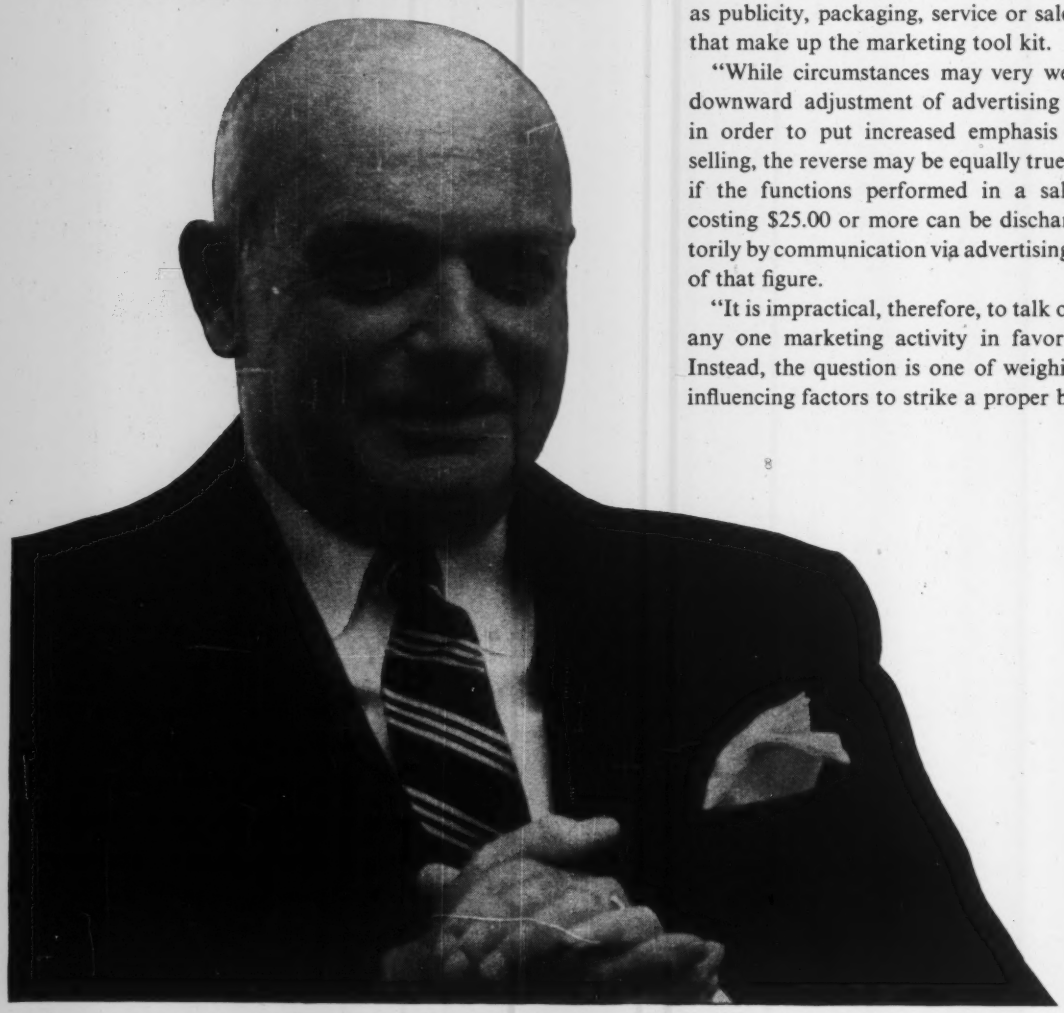
MODERN TALKING PICTURE SERVICE INC.
Three East 54th Street, New York, N. Y.

POWER PIPING DIVISION • THE M. W. KELLOGG COMPANY
Plant & Headquarters: Williamsport, Pa. *Sales Offices:* 711 Third Ave., New York, N.Y.
A SUBSIDIARY OF PULLMAN INCORPORATED

Offices of other Kellogg companies: Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

"Why not cut out advertising and use the money to hire more salesmen?"

ROBERT HELLER, for 30 years a consultant to management of leading industrial firms and head of Robert Heller & Associates, Inc., Cleveland, answers a question that has crossed the minds of countless business executives.



"Advertising, although indispensable in our modern economy, can never perform the entire marketing job by itself. But neither can direct selling, nor any other single one of such sales-producing influences as publicity, packaging, service or sales promotion that make up the marketing tool kit.

"While circumstances may very well indicate a downward adjustment of advertising expenditures in order to put increased emphasis on personal selling, the reverse may be equally true. Particularly if the functions performed in a salesman's call costing $25.00 or more can be discharged satisfactorily by communication via advertising at a fraction of that figure.

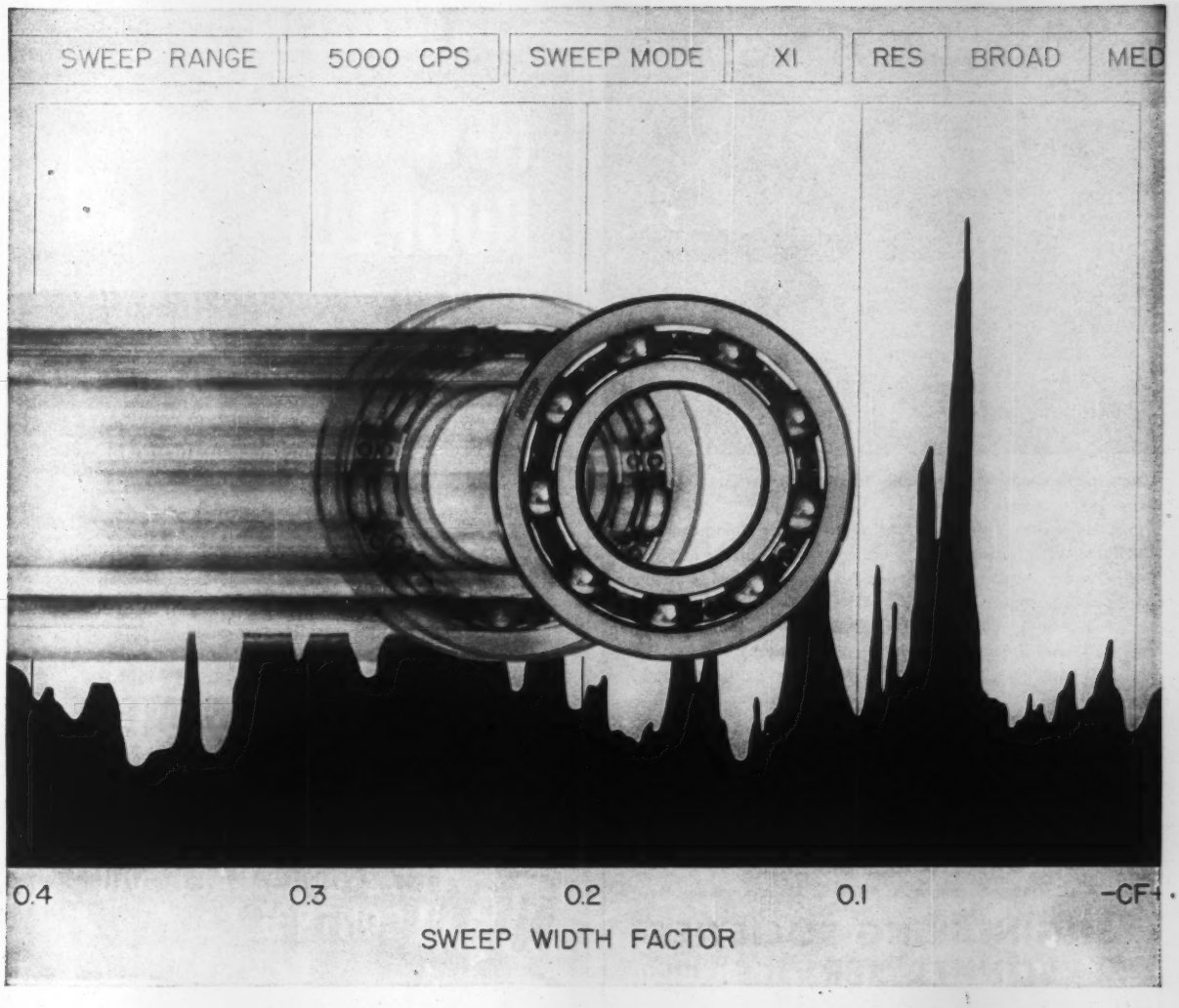
"It is impractical, therefore, to talk of eliminating any one marketing activity in favor of another. Instead, the question is one of weighing all of the influencing factors to strike a proper balance."

AIA

ASSOCIATION OF INDUSTRIAL ADVERTISERS

271 madison avenue • new york 16, n. y. • telephone murray hill 5-8921

An organization of over 4000 members engaged in the advertising and marketing of industrial products, with local chapters in ALBANY, BALTIMORE, BOSTON, BUFFALO, CHICAGO, CLEVELAND, COLUMBUS, DALLAS, DENVER, DETROIT, HAMILTON, ONT., HARTFORD, HOUSTON, INDIANAPOLIS, LOS ANGELES, MILWAUKEE, MINNEAPOLIS, MONTREAL, QUE., NEWARK, NEW YORK, PHILADELPHIA, PHOENIX, PITTSBURGH, PORTLAND, ROCHESTER, ST. LOUIS, SAN FRANCISCO, TORONTO, ONT., TULSA, YOUNGSTOWN.



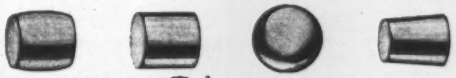
Now, SKF reduces the noise level of ball bearings by 50%!

New SKF ball bearings run twice as quietly as standard single-row deep-groove bearings — six times more quietly than bearings produced just two years ago.

They're designed especially for applications where noise is an important factor. Eight manufacturers, who use-tested them for over a year, now back-up their approvals with repeat orders.

Every bearing meets new, more critical standards. Each type and size meets special requirements for reduced vibration. Every ball meets very low waviness limits. Each cage meets critical standards for smooth, quiet performance.

SKF will make a comparison check of these improved bearings against the bearings you're now using. See for yourself! Just call the SKF branch office nearest you. 6013



Spherical, Cylindrical, Ball, "Tyson" Tapered and REED Miniature Bearings

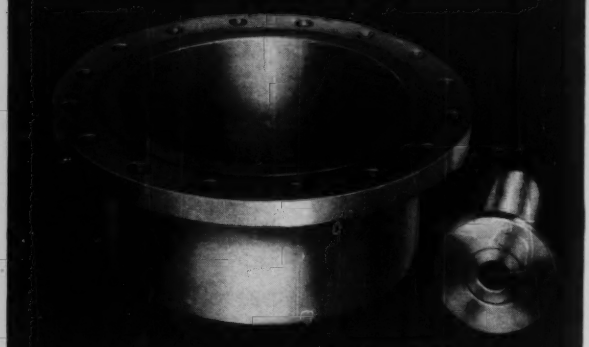
EVERY TYPE—EVERY USE

SKF®

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.

REG. U.S. PAT. OFF.

WHY FABRICATE NECKS?



Lenape Seamless Forged Welding Necks

. . . especially when it usually *costs less* to buy seamless forged welding necks from Lenape.

Lenape also offers the widest selection of welding connections available—reinforcing necks, studding outlets, nozzles and unique flange and extension combinations. For maximum design efficiency and economy, contact Lenape.

Full details and specifications are given in the 96-page Lenape General Catalog. Write for your copy.

LENAPE

Red Man Products

LENAPE HYDRAULIC PRESSING & FORGING CO.
DEPT. 114 WEST CHESTER, PENNSYLVANIA

NEW BOOKLET

describes most efficient gas-to-gas heat exchanger of its size ever developed

Roto-Pak®, Air Preheater's newest gas-to-gas heat exchanger, packs more performance in less space than any heat exchanger you've ever seen. For example:

Size range: average 1′ depth x 20″ to 55″ diameter
Efficiency: recovers up to 90% of available Btu's
Capacity: handles up to 30,000 lbs/hr
Temperature range: up to 1000°F
Weight: less than 200 lbs for most models

For more information send for your copy of this 16-page color brochure. Simply write to

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

Opportunities Unlimited

ENGINEERING SOCIETIES PERSONNEL SERVICE INC. (AGENCY)

SECURITY...TOP WAGES... CHALLENGING ASSIGNMENTS

Qualified Engineers! Thousands of positions available with leading organizations. . . Employer pays fee in many cases.

Under the auspices of the Five Founder Engineering Societies and affiliated with other renown Engineering Societies, E.S.P.S. offers many years of placement experience in addition to world wide contacts.

Write for E.S.P.S. weekly Bulletin of Positions Available. . . See a partial listing of available positions in Personnel Section.

DON'T DELAY—REGISTER TODAY

Offices In Major Cities In U. S.

New York	Chicago	San Francisco
8 West 40th St.	29 East Madison St. Room 812	57 Post St.

NEW 72-page GAGE and CONTROL Catalog

..tells where to use them.. ..WHY and HOW!

Illustrates instruments and gages...*diagrams* their installation and on-the-job use... *charts* valuable performance data.

For the efficient measurement of combustion • draft • pressure • flow • vacuum • CO_2 • smoke • velocity • static pressure • pressure differential • temperature • and others.

Write for your free copy of this valuable book today!

Dwyer CONTROLS GAGES

F. W. DWYER MFG. CO.

P. O. BOX 373-ME, MICHIGAN CITY, INDIANA

THERMOCOUPLES
THAT WILL WITHSTAND
3000°F AND
UP TO 50,000 PSI

LONG LIFE
Sheath Diameters, .04 to .32
Thermocouple Lengths to 100 feet
Complete Thermocouples made to every requirement.

NEW, SIMPLE CONSTRUCTION

A metallic sheath compressed over ceramic insulated wire. Sheath can be bent and weldments can be performed without loss of insulation.

Write For new Bulletins

3.8 for complete thermocouples
4 for AEROPAK Ceramic insulated wire.

VSMF-REEL F

Aero Research
INSTRUMENT COMPANY, INC.

DEPT M.E., 315 NORTH ABERDEEN • CHICAGO 7, ILL.
Sales Representatives throughout the United States and Canada

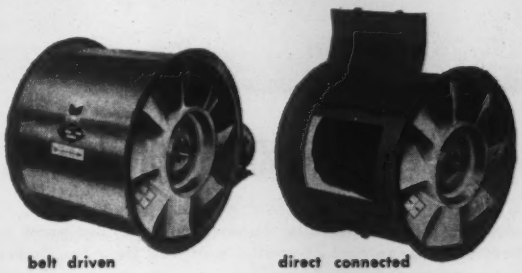
NEW 8 blade

Aerovent FANS

tubeaxial fans

high speed - high efficiency

Aerovent's new Tubeaxial Fan, designed around a new 8-blade "Macheta" Airfoil Axial Flow Propeller, offers top performance against medium pressures at speeds to 3450 RPM. Available in 16", 18", 24", and 30" diameters, this unit combines speed, stamina and modern functional design. Easily installed in present ductwork or engineered to new construction, it's the right answer for resistances to 4" SP. Another outstanding development from Aerovent—America's finest industrial fans and air equipment.



belt driven direct connected

WRITE FOR FREE BULLETIN 350

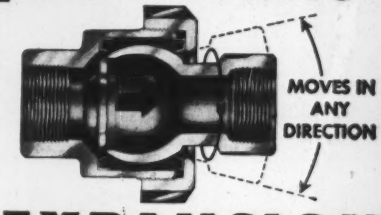
Air deliveries of Aerovent equipment determined in accordance with established and accepted codes and guaranteed by manufacturer.

CERTIFIED PERFORMANCE

Aerovent FANS
Aerovent
FAN COMPANY, INC.
ASH and BEACH STS. PIQUA, OHIO

BARCO Flexible BALL JOINTS

NOW! An easy way to solve



PIPE EXPANSION PROBLEMS

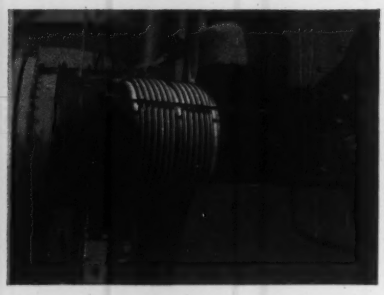
Send for New Bulletin No. 31

Barco Flexible Ball Joints make it easy and economical for you to solve many problems where piping EXPANDS and CONTRACTS!

- No heavy pipe anchoring required. No "end thrust" developed under pressure. Minimum space needed.
- Ability to handle compound movement where twisting is also involved.
- Virtually no deterioration. Able to stay in service for years. No lubrication.
- Maximum safety for high temperature and pressure. Sizes ¼" to 12".

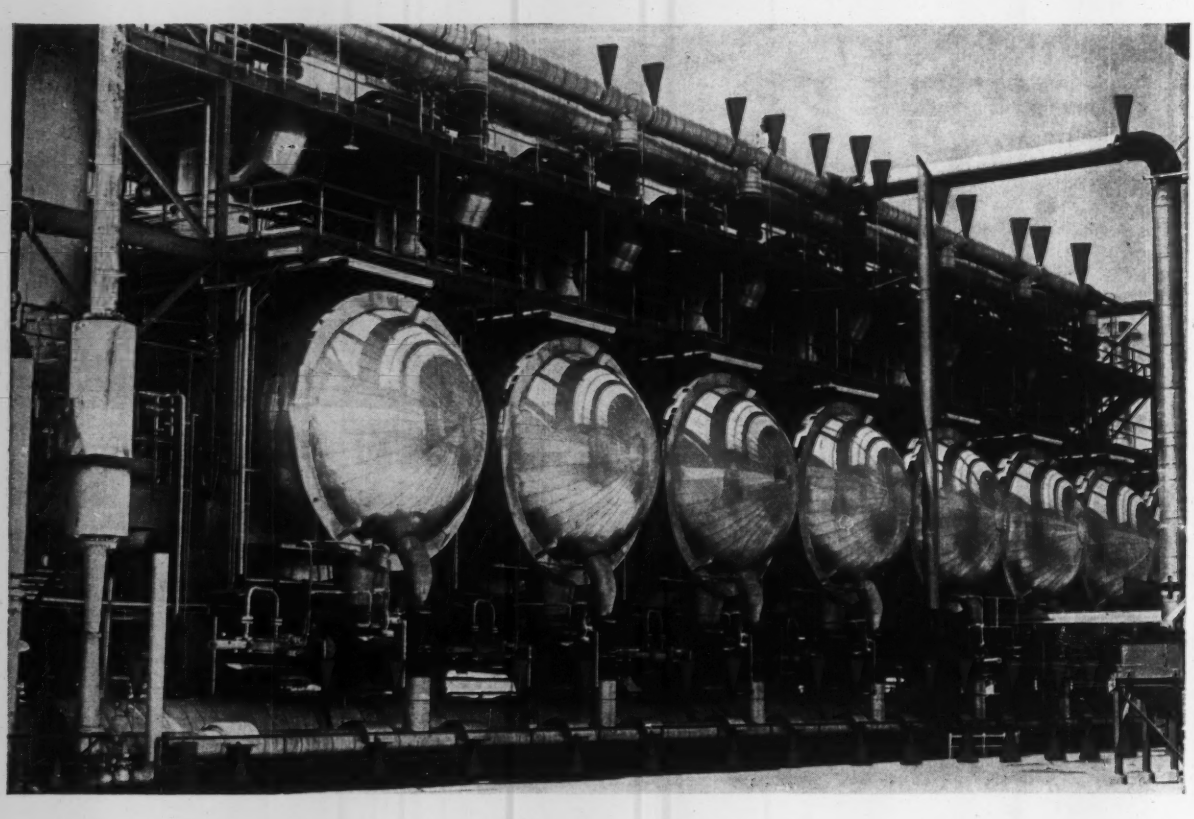
Read interesting Bulletin 31, "How to Solve Piping Flexibility Problems". Complete with piping layout drawings and illustrations. Shows how to cut costs, save time, and do a better job! *Ask for recommendations.* BARCO MFG. CO., 521N Hough St., Barrington, Illinois.

85½ in. dia. expansion joint connecting quench and pre-quench towers. Pinned structural ties permit expansion joint to absorb axial and differential vertical movement.



48 in. dia. expansion joint at compressor discharge. Double bellows permit large axial movement. Internal sleeve guide provides for stability, minimum pressure drop.

54 in. dia. hinged expansion joints in loop to pre-quench tower. They absorb 5⅜ in. vertical expansion and 7⅜ in. horizontal expansion due to 1200°F temperature in reactor header.



125 ZALLEA EXPANSION JOINTS, 125 demands for maximum reliability

Expansion joints, specially engineered and designed by Zallea, solve problems of space, heat and flow for Odessa Butadiene Co., Odessa, Texas.

Large-diameter piping (up to 72 in. dia.), with short, straight runs and critical flow conditions, posed new design problems. High temperature operation (1200°F) required minimum loading on sensitive equipment. Open-air construction, with few load carrying members dictated maximum stability of expansion joints with minimum use of external guides and anchors to support pipe weight and resist wind loading.

To solve these problems called for a competent, close-working team of process, piping and structural engineers from Fluor Corp. Ltd., design engineers from Odessa Butadiene Co., and application engineers from Zallea.

Result: A compact, reliable piping-expansion joint system that permitted containment of an efficient, 50,000 ton per year unit in an area whose largest dimension is a few hundred feet.

This is another example of how Zallea experience in handling critical, complex Expansion Joint applications can save time and money. For more facts, call us . . . or write for catalog 56.

ZALLEA BROTHERS, Taylor and Locust Sts., Wilmington 99, Del.

Zallea **FOR MAXIMUM RELIABILITY**

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

OPPORTUNITIES

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $4.00 a line. $2.00 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single column units of multiples of one inch at flat rate of $40.00 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

POSITIONS OPEN

WANTED MECHANICAL ENGINEER

Large building materials manufacturer in south has position for an engineer with proven creative ability in the field of process and automatic machine design. Insulation or paper industry experience desirable. Must be willing to spend time on board and eventually head up a division in central engineering. Reply in first letter should give information relative to education, experience and previous employment together with salary requirements.

Address CA-7059, care of "Mechanical Engineering."

OVERSEAS

Robert College, in Istanbul, Turkey, presents a challenge in education in a vital part of the world. West and Middle East are contributing side by side to the development of a young and vigorous nation. Opportunities are available in engineering, business administration and economics, the sciences, and the humanities. Graduate degrees required.

Address inquiries to **Dr. Howard P. Hall, Dean of Faculty, Robert College, Bebek Post Box 8, Istanbul, Turkey; with copy to the Near East College Association, 548 Fifth Avenue, New York 36, New York.**

RESEARCH ENGINEER

Research in Heat Transfer related to Nuclear Reactors. Degree in Mechanical or Chemical Engineering; knowledge machine design and shop practices; good grounding in theoretical aspects of engineering science essential. U.S. citizen.

BENEFITS INCLUDE TUITION EXEMPTION AND LIBERAL VACATION POLICY

SEND RESUME TO:
MRS. F. J. McNALLY
COLUMBIA UNIVERSITY
Engineering Research Laboratories
632 W. 125 St. NYC 27
(Do Not Telephone)

CHEMICAL OR MECHANICAL ENGINEERS

One of the world's largest pharmaceutical companies has available varied and challenging assignments in Plant Engineering. About five years' experience required in the process industries. Applicants should be capable of assuming full responsibility for project design and coordination. Knowledge of construction methods and chemical maintenance desirable. Send resume to **Personnel Dept., Parke-Davis Detroit, 32, Michigan.**

MANAGER, DESIGN ENGINEERING

Large midwestern natural gas company will employ a graduate, professional engineer for this position. He must have at least 10–15 years' experience in compressor, process, and pipeline design. 3–5 years' fully responsible supervision of such work is required.

This is an excellent opportunity for rewarding work and personal development. Stock purchase, pension and other employee benefit plans are excellent. Age limit 45. Send your complete, detailed resume, including salary requirements. Address CA-7070, care of "Mechanical Engineering."

DEVELOPMENT AND SALES ENGINEERS

VALVES and mechanisms for critical high-pressure, high-temperature services in the growing marine, petroleum, process and power fields—including nuclear power.

CONTACT J. M. Evan, Edward Valves, Inc., subsidiary of Rockwell Manufacturing Company, 1200 W. 145th St., East Chicago, Indiana.

MECHANICAL ENGINEER

Graduate Mechanical Engineer with minimum of four years experience in petroleum refinery or related engineering. Will be responsible for mechanical design and cost estimate of refinery processing equipment.

Duties will be closely integrated with operation of a modern, independent refinery which includes crude distillation, catalytic cracking, polymerization, coking, hydrosulfurization, catalytic reforming, alkylation, and utilities.

Send complete resume of education and experience, including salary requirements. All replies confidential.

GREAT NORTHERN OIL COMPANY
P. O. Box 3596
St. Paul 1, Minnesota
ATTN.: C. L. Dretzke

PLASTIC MATERIAL SPECIALIST

Plastics Evaluation Center, Department of Defense establishment at Picatinny Arsenal, Dover, New Jersey, is seeking an individual with a thorough knowledge of mechanical and physical properties of plastic materials used in missiles and aircraft. Applicant must have ability to prepare reports on selected aspects of plastics technology. Considerable travel. Graduate mechanical, aeronautical or chemical engineer preferred. Salary to $10,635. Liberal leave policy, other benefits. Transportation expenses, including movement of household goods, paid for selected applicants who reside more than 20 miles from worksite. Position is in the Career Civil Service. Send resume to

Civilian Personnel Office
Picatinny Arsenal, Dover, New Jersey

OPPORTUNITIES FOR ENGINEERS IN AIR POLLUTION RESEARCH PROGRAM

Several openings are now available for qualified chemical or mechanical engineers in the Engineering Research & Development Section, Division of Air Pollution, Public Health Service. Assignments in air pollution engineering research activities may involve problems associated with the air pollution aspects of combustion processes, automotive exhaust emission, and gaseous and particulate control devices. These positions offer above average opportunities for advancement as a result of expanding air pollution activities by the Public Health Service. Starting salary range $5,335 to $10,635 per year. Civil Service benefits and requirements apply. For additional details regarding positions now open, write to **Director, Robert A. Taft, Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio**

MECHANICAL ENGINEERS

There is an outstanding career opportunity for you in the chemical industry.

Positions currently open in Missouri, West Virginia, and Alabama for engineers qualified in the following areas:

Plant Technical Service

Work involves basic equipment design and project engineering through specifications and plant start-up. Responsibilities include design of new, improved, and enlarging facilities.

Maintenance and Construction

Assignments involve maintenance of existing equipment at optimum operating efficiency as well as the construction of new installations prepared by the design engineering group.

Up to 8 years' experience in either area desirable.

All replies confidential. Please send resume to:

H. S. Scott, Manager
Technical Employment

Monsanto Chemical Company
Organic Chemicals Division
St. Louis 66, Missouri

MECHANICAL ENGINEERS

BRUNSWICK CORPORATION is expanding its Research and Development Division and offers outstanding career opportunities for graduate Mechanical Engineers qualified to handle positions involving

- **AUTOMATIC MACHINERY DESIGN**
- **PRODUCT DESIGN and DEVELOPMENT**

This is an opportunity to associate with a company recognized as a leader in the recreational field, and whose growth and stability has been outstanding. Positions offer good opportunities for technical advancement and long-range careers. Openings available at various levels from recent college graduates, Senior Design and Project Engineers to Engineers who have supervisory experience. New and modern engineering offices offer excellent work environment. The company is located in Western Michigan, "Heart of Michigan Vacationland" offering excellent opportunities for family recreational activities. Positions offer challenging work, attractive starting salaries commensurate with experience, along with excellent fringe benefits.

Send replies outlining education, experience, and salary desired, to A. J. Nelson.

Brunswick
CORPORATION
MUSKEGON, MICHIGAN

Air Conditioning Development Engineer

An action-geared Midwestern client firm . . . noted for soundly engineered, attractively designed and thoroughly high quality products . . . is seeking an alert, business-minded and professionally-motivated engineer who will make these contributions to the firm's Engineering Division:

- **Engineer—Packaged Air Conditioning Products**
  Concentrating on the development of package refrigeration units—supervise design, analysis and testing of air conditioners, heat pumps and accessory packages. Must have B.S. Engineering and 5 years minimum in the development of related equipment.

The successful candidate will possess technical capability, well-rounded personality and demonstrated growth potential for future increased responsibility.

Attractive salary commensurate with experience. Liberal benefits. All searching and relocation fees paid.

Confidential replies by duplicate résumé to M. L. Baas, Executive Search Division MUST include all specifics and present compensation.

BUTTRICK & MEGARY
ORGANIZATION BUILDERS FOR 29 YEARS
Western Saving Fund Building
Philadelphia 7, Pa.

PROCESS ENGINEERS
for large midwestern manufacturer

Experienced management now required to handle Production Engineering responsibilities in the following areas:

- √ Large Welding and Fabrication Operations
- √ Large Machining and Assembly Operations
- √ Electrical Equipment Manufacture (Rotating & Non-Rotating)
- √ Manufacturing Development

Qualified candidates must have an engineering degree as well as thorough and extensive management experience. They must have the ability to manage a Production Engineering Section consisting of at least 50 technical and engineering employes. They will be responsible for:

1. Planning of all Production operations
2. Specification of Machine Tools and Tooling requirements
3. Manufacturing Cost Control of one or more product lines

ENGINEERS (Ages 25–45) with these qualifications are invited to submit their personal, academic and experience background. Also, salary expected.

Address CA-7060, care of "Mechanical Engineering."

RESEARCH ENGINEERS

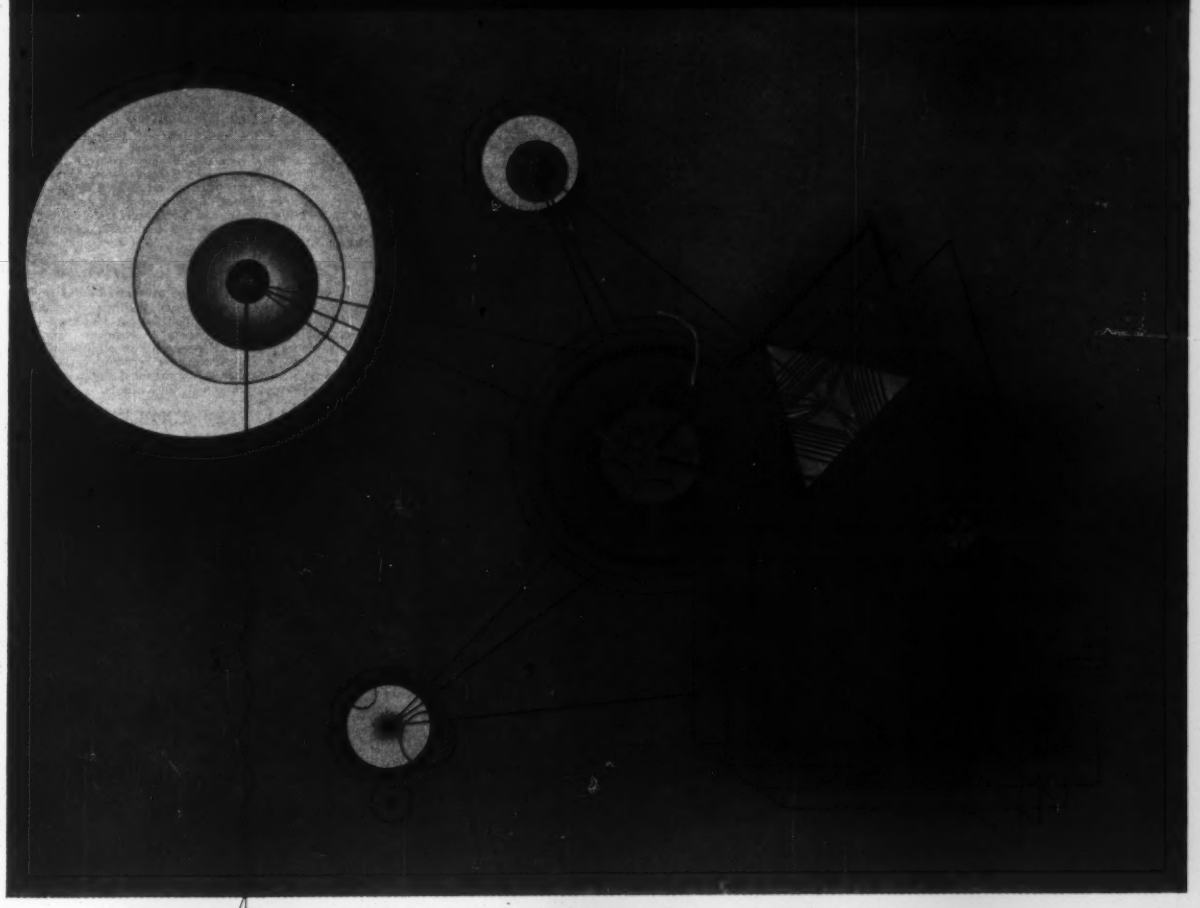
With PhD in Mechanical Engineering and varied interests in the mechanical engineering field for experimental and analytical research to originate mechanisms, power and process equipment. 2–3 years' industrial experience preferred. Write, giving details, etc., to:

J. T. Jarman
Assistant to Vice President in Charge of Research
Allis-Chalmers Mfg. Co.
Post Office Box 512
Milwaukee 1, Wisconsin

Project Vela's

EYE IN THE SKY

is designed to detect nuclear explosions in space. Opportunities to work on this, and other advanced research programs at Los Alamos, exist for Ph.D. physicists in atomic and molecular physics, ionic collision processes, and upper atmosphere physics. Also available are challenging positions for chemists and engineers.



For employment write to: Personnel Director, Division 60-116

los alamos
scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
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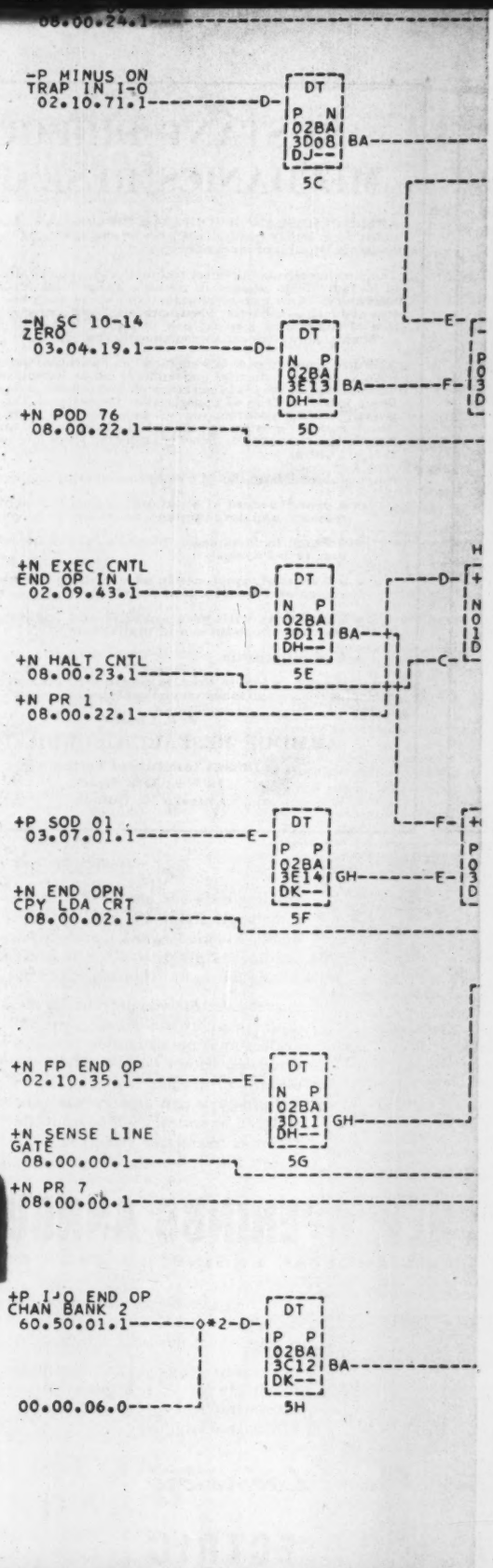

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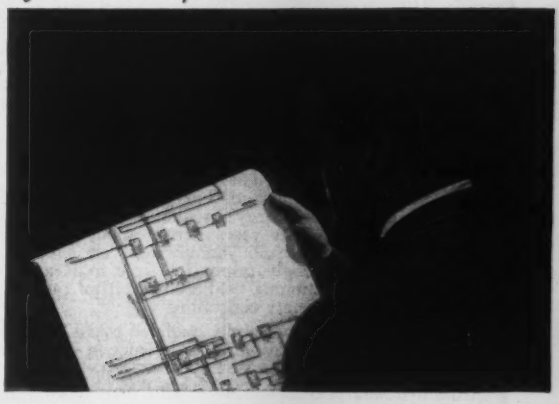

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MECHANICAL ENGINEERING

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A HISTORIC TELEPHONE EXPERIMENT BEGINS IN AN ILLINOIS TOWN

New technology brings the dream of an electronic central office to reality . . . foreshadows new kinds of telephone service.

Today, the science of communications reaches dramatically into space, bouncing messages off satellites. But an equally exciting frontier lies closer to home. Bell Telephone Laboratories engineers have created a revolutionary new central office. At Morris, Illinois, an experimental model of it has been linked to the Bell System communications network and is being tried out in actual service with a small group of customers.

This is a special electronic central office which does not depend on mechanical relays or electromagnets. A photographic plate is its permanent memory. Its "scratch pad," or temporary memory, is a barrier grid storage tube. Gas-filled tubes make all connections. Transistor circuits provide the logic.

The new central office is versatile, fast and compact. Because it can store and use enormous amounts of information, it makes possible new kinds of services that will be explored in Morris. For example, some day it may be feasible for you to ring other extensions in your home . . . to dial people you frequently call merely by dialing two digits . . . to have your calls transferred to a friend's house where you are spending the evening . . . to have other numbers called in sequence when a particular phone is busy.

The idea behind the new central office was understood 20 years ago, but first Bell Laboratories engineers had to create new technology and devices to bring it into being. A Bell Laboratories invention, the transistor, is indispensable to its economy and reliability.

This new experiment in switching technology is another example of how Bell Telephone Laboratories works to improve your Bell communications services.

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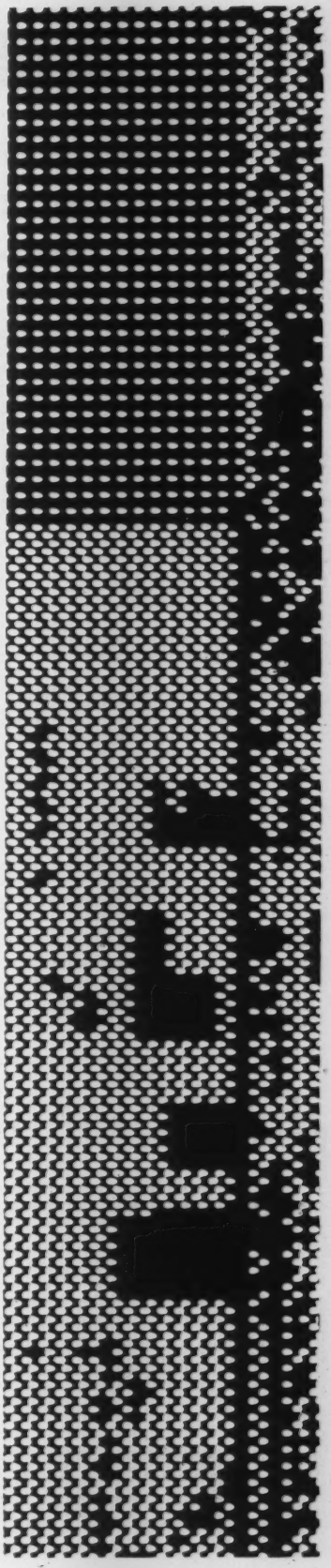

Part of a memory plate of the new electronic central office is shown at right (enlarged 8 times). Spots are coded instructions which guide the system in handling calls and keeping itself in top operating form. Over two million spots are required. Logic and memory are physically separated in the machine, so new functions can be easily added. The experiment is being conducted in co-operation with the Illinois Bell Telephone Company and the Western Electric Company.

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Chace Thermostatic Bimetal

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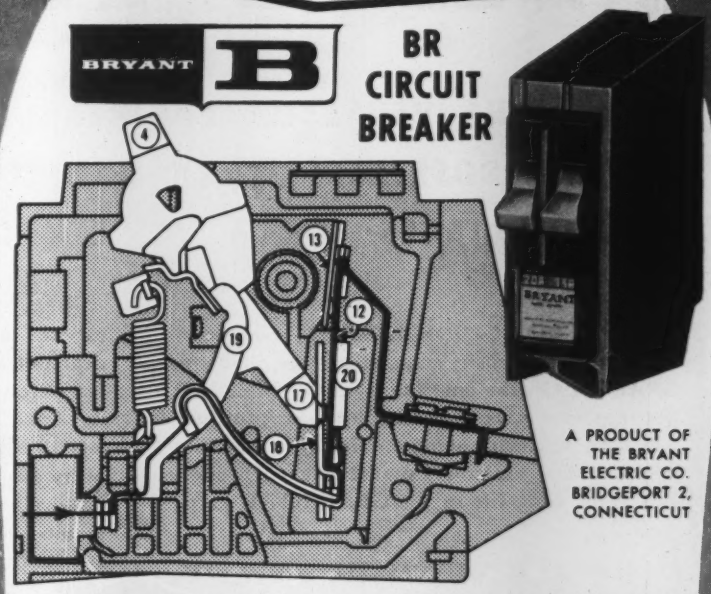
BRYANT B

BR CIRCUIT BREAKER



A PRODUCT OF THE BRYANT ELECTRIC CO. BRIDGEPORT 2, CONNECTICUT

Interchangeability, compactness and sturdiness are three features readily apparent in Bryant's BR Circuit Breaker. The ***mounting dimensions*** make it interchangeable with five other makes; there are ***two*** breakers in the space formerly used for one; the mechanism is supported and enclosed by a husky ***metal frame*** and is completely independent of the insulating case.

Not so readily apparent is the "heart" of the BR Breaker. The all-important thermal-magnetic "nerve center" includes:

Time-delay controlled by the load bimetal (12) for overload protection . . . ***overload bends free end of bimetal to right disengaging trigger (17) from armature (18) causing contact arm (19) to open.***

Second bimetal (13) of the "force balance" type, providing enclosure — ***ambient — compensation . . . as load bimetal (12) bends to right with rising ambient temperature, compensating bimetal (13) bends left, removing pressure from (12).***

Magnet (20) reacts instantly by releasing trigger (17) at about 1000% rating to limit fault current damage.

The load bimetal and the compensating bimetal are made of dependable Chace Thermostatic Bimetal. This dependability is born of two most important factors: 1. Uniformity that comes from the manufacture of precision bimetal, ***always made to specifications.*** 2. Experience. Chace has specialized in one product—***and one product only***—for more than a third of a century. Manufacturers' valuable names are safe on the outside with Chace Thermostatic Bimetal on the inside of their products.

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Thermostatic Bimetal
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(CARBON-GRAPHITE)

THE VERSATILE ENGINEERING MATERIAL THAT POSSESSES MANY UNIQUE AND PRACTICAL ADVANTAGES FOR A VARIETY OF APPLICATIONS

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RESISTANCE TO CHEMICAL ATTACK—GRAPHITAR has the ability to withstand the action of almost any chemical, with the exception of the most highly oxidizing re-agents in hot and concentrated form. GRAPHITAR parts, for example, operate efficiently in steam, chemical and gas valves to provide a corrosion resistant material operating under the most adverse conditions.

MECHANICALLY STRONG – GRAPHITAR will not warp or distort even in high pressure applications. Compressive strength up to 45,000 psi and transverse breaking strength from 3000 to 16,000 psi, depending on the grade.

HEAT RESISTANT—GRAPHITAR is not affected by heat under neutral or reducing conditions. Temperatures of oxidation for most grades is approximately 700 degrees F. In addition, GRAPHITAR engineers have developed a special oxidation resistant grade of GRAPHITAR that has been exposed in an oxidizing atmosphere (air) of 1200 degrees F. and after 200 hours, it showed a weight loss of less than six per cent.

MOLDABLE—GRAPHITAR has excellent moldability properties that make possible and practical unusual shaped parts. Design requirements such as ears, face slots, and outside diameter notches can easily be incorporated into GRAPHITAR parts without secondary machining and finishing operations.

MACHINING—The United States Graphite Company operates an excellent finishing department to do all finishing operations to the most exacting specifications. GRAPHITAR may be ground to size or shaped with a tungsten carbide or diamond tipped tool to tolerances as close as .0005". When surfaces require a high degree of precision in flatness, lapping and polishing equipment are employed and accuracies within three light bands can be produced.

LIGHT WEIGHT—GRAPHITAR is lighter than magnesium and is being employed increasingly in the aircraft and missile fields. The weight per unit volume of various GRAPHITAR grades is as follows: 102.8 to 116.03 pounds per cubic foot, .0595 to .0672 pounds per cubic inch, .952 to 1.074 ounces per cubic inch.

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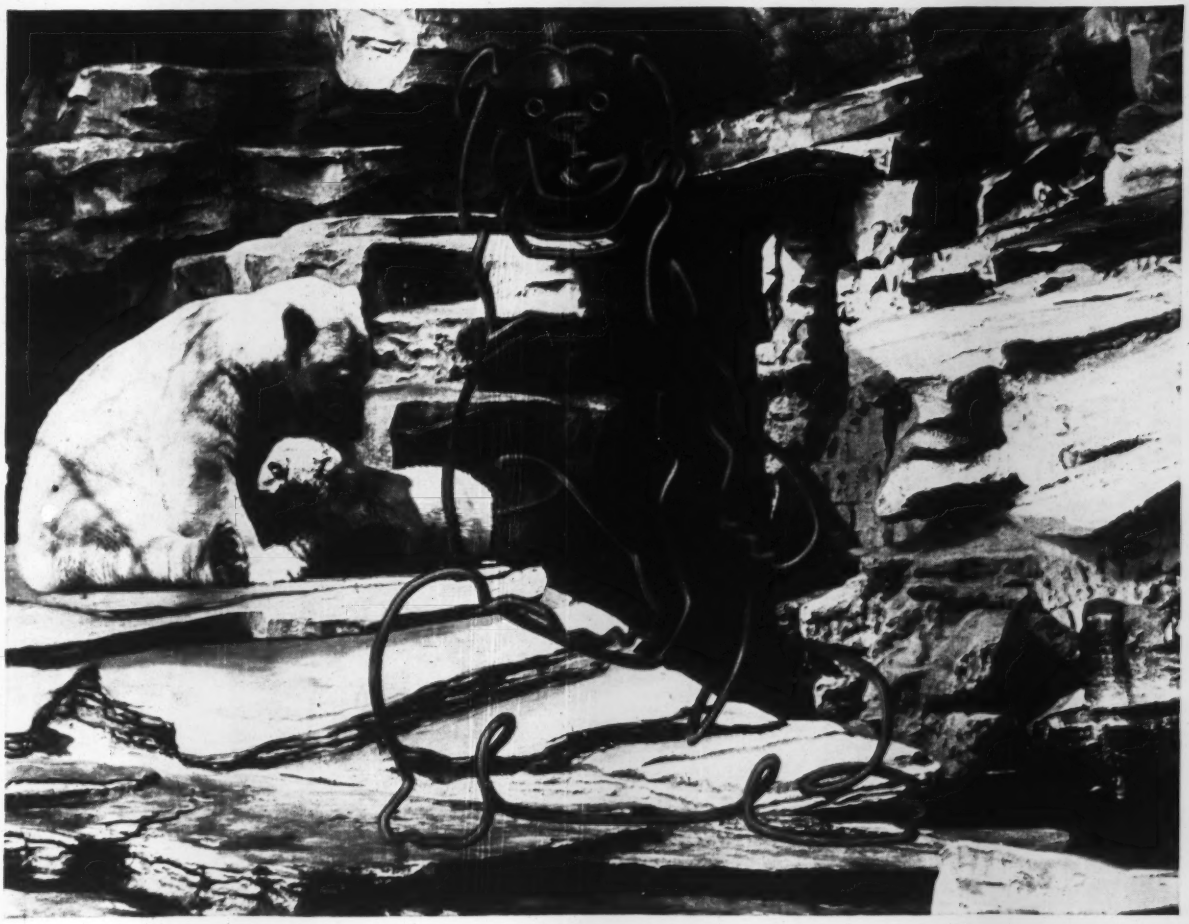
DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

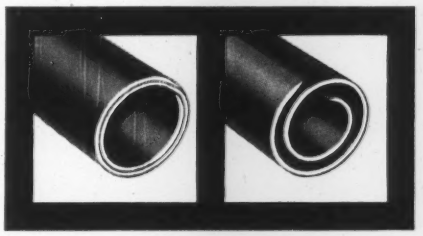
GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDER METALLURGY • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES



Bundy can mass-fabricate practically anything

Almost any tubing component you may need—simple or complex—can be mass-fabricated by Bundy. If you are planning a new product, Bundy specialists will work with you at any time to iron out kinks in tubing problems. Or perhaps Bundy engineers can help you simplify the design—and cut costs—of existing tubing components. And when you specify Bundy you get superior tubing. Bundyweld® meets ASTM 254; Government Specification MIL-T-3520, Type III. Phone, write or wire: Bundy Tubing Company, Detroit 14, Michigan.

* * *



Bundyweld, double-walled from a single copper-plated steel strip, is metallurgically bonded through 360° of wall contact. It is lightweight, uniformly smooth and easily fabricated . . . has remarkably high bursting and fatigue strengths. Sizes up to 5/8" O.D.

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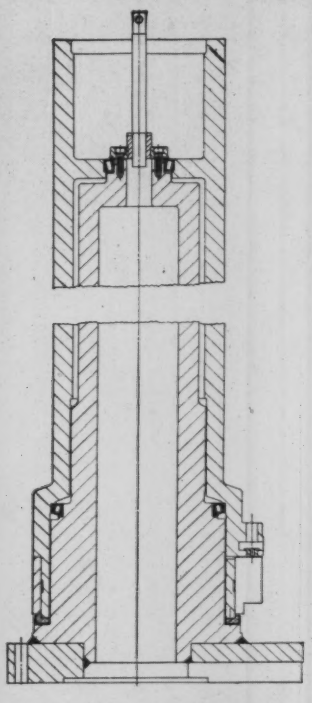
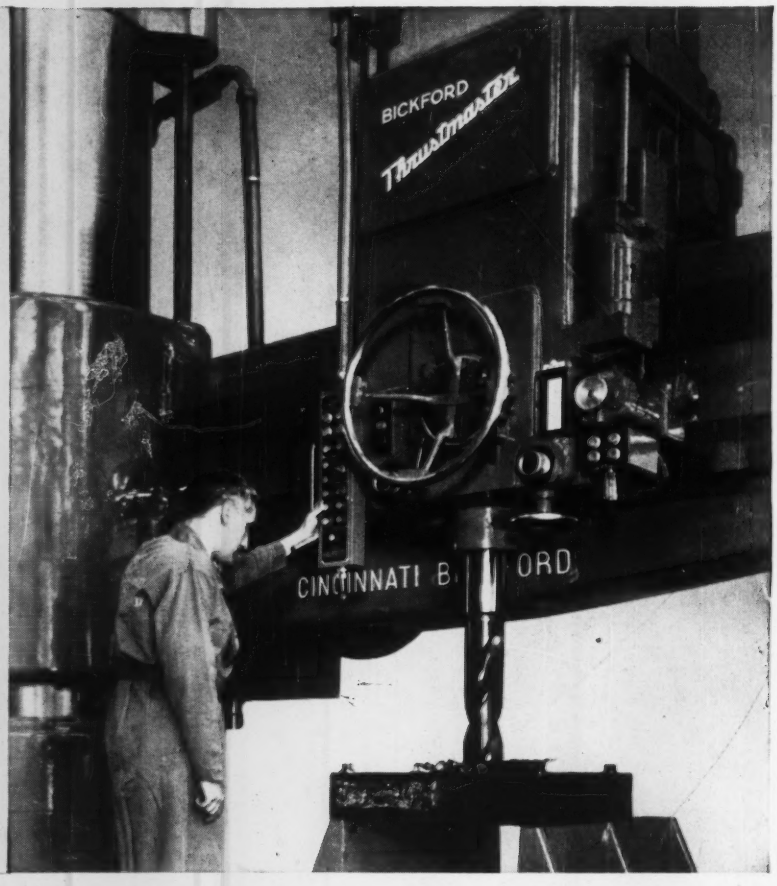


How **CINCINNATI-BICKFORD** mounts column of "Thrustmaster" radial drill on Timken bearings to assure rigidity.

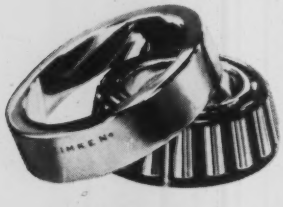


World's most powerful radial drill uses 41 Timken® bearings to assure rigidity, handle extreme loads

WEIGHING 80,000 lbs. and driven by a 50 h.p. electric motor, this 34-inch diameter column "Thrustmaster", by Cincinnati-Bickford Division of Giddings & Lewis Machine Tool Company, is the world's most powerful radial drill. To resist stresses and reduce arm deflection, the column is mounted on large pre-loaded Timken® bearings—one at the top, one at the bottom. They give the column and sleeve the rigidity of a single piece, resulting in greater accuracy and longer tool life, with higher speeds and coarser feeds. And 39 more Timken tapered roller bearings are used in the drill head. Timken bearings assure better performance because they . . .

1) *Take all loads.* Their taper lets Timken bearings take *both* radial and thrust loads. And full-line contact between rollers and races gives extra load-carrying capacity. 2) *Practically eliminate friction.* Timken bearings are geometrically designed and precision-manufactured for true rolling motion.

And Timken bearing service from graduate engineer salesmen qualified to work with your purchasing, engineering and production people is an *extra* advantage. It's service, backed by research and testing facilities unique in the bearing industry. ***That's why Timken bearings give you:*** *1) Quality you can take for granted. 2) Service you can't get anywhere else. 3) The best-known name in bearings. 4) The pace setter in lower bearing costs.* Specify Timken bearings for the machines you use or buy. The Timken Roller Bearing Company, Canton 6, Ohio. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.* Canadian Division: Canadian Timken, St. Thomas, Ontario.



Industry rolls on

TIMKEN®

tapered roller bearings